THE

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CONTENTS:

	PAGE
The Standardising of Generators, Motors, and Transformers ...	713
The Institution of Electrical Engineers	716
Universal Shunt (*illustrated*)	717
Deadbeat Sensitive Indicating Galvanometer (*illustrated*) ...	718
Electric Railway Motors	718
Aluminium and Other Electro-Chemical Industries at Foyers...	719
Société Internationale des Electriciens	719
The Telephone Inquiry (*continued*)	720
Correspondence:—Limerick Electric Tramway Scheme ...	722
Testing of Magnet Steel in Bulk	723
"Honour to Whom Honour is Due"...	723
Alternating Arc Lamp...	723
The Hart Secondary Battery	723
Business Notices, &c.	724
Notes	731
City Notes	737
Traffic Receipts	738
Share List of Electrical Companies	739
The Physical Society...	740
The Institution of Electrical Engineers:—	
The Prevention of Interruptions to Electricity Supply (*illus.*) (*concluded*)	741
Failure of Copper Pipes	743
Northern Society of Electrical Engineers	744
The Telephone Service.—Conference at Spring Gardens ...	745
Electric Lighting in St. Pancras during 1897-1898	746
Electrical Engineers (R.E.) Volunteers	747
Reviews:—A Treatise on Magnetism and Electricity	747
The Standard Electrical Dictionary	747
Practical Telephony	748
A Popular Guide to Commercial and Domestic Telephony	748
First Stage Magnetism and Electricity	748
New Patents	748

THE

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THE STANDARDISING OF GENERATORS, MOTORS, AND TRANSFORMERS.

THE title of this article names the subject set for discussion at a recent meeting of the American Institute of Electrical Engineers at New York, and in opening this meeting the president said that, although the general desirability of standardising electrical apparatus had often been spoken of, and seemed to be generally believed in, yet people were by no means agreed as to the feasibility or policy of the Institute taking steps in that direction; and he, therefore, suggested to the meeting, as proper subjects for discussion, the general question of the advisability of fixing standards, what standards should be fixed, and how far they should go. Mr. E. W. Rice, jun., then opened the discussion, and after referring to the great advantages which accrued from establishing certain standard types and sizes of apparatus, said that, in his opinion, standardising in this direction was a matter which the Institute should not deal with. There were, however, certain features of the subject under discussion which, it seemed to him, could and should properly be considered by the Institute; and he then suggested seven subjects, as follows:—

1. *Definition of Efficiency.*—Mr. Rice stated that electrical efficiency was still sometimes confused with commercial efficiency, and that a more exact definition of the term "commercial efficiency" was wanted, as in the United States the mechanical losses, friction, and windage of the dynamo were debited to the prime mover in the case of direct-coupled machinery, and to the dynamo in the case of belt-driven machinery.

2. *Heating Limits, and Methods of Determining the Same.*—Mr. Rice did not advocate the adoption of any definite number of degrees rise of temperature as a standard, but pointed out the necessity of better defining the methods to be employed for measuring this rise of temperature.

3. *Regulation.*—As an illustration of the necessity of a more accurate definition of what was meant when it was stated that a machine should regulate within a certain percentage, it was mentioned that many different definitions of the term regulation, as applied to alternating current machinery, were in actual use by different engineers; amongst them being the percentage drop in terminal pressure from no load to full load, with constant open circuit excitation; the percentage rise of terminal pressure from full load to no load with constant full load excitation; and the percentage increase or decrease of excitation required to maintain a constant terminal pressure from no load to full load, or *vice versâ*.

4. *Sparking.*—Mr. Rice thought they must all admit that this was a difficult matter to standardise; but he suggested

that the meeting might consider whether they could not define the limits between which freedom from sparking should be demanded for commutating machinery.

5. *Insulation and Methods of Testing.*—As it was frequently specified that the insulation of a generator or motor should withstand certain breakdown tests by being subjected to a pressure considerably higher than its working pressure; Mr. Rice suggested that, although it was perhaps too early, in view of the rapid development of the industry, to determine definitely the limits and conditions of such tests; yet the subject might be discussed with profit, and perhaps some useful recommendations be made.

6. *Rating.*—As an illustration, Mr. Rice mentioned that it was customary in the United States to rate alternating current machinery on the basis of volt-amperes output, whereas in other countries the rating was often based upon the volt-amperes output multiplied by an assumed cosine of the angle of lag, and he suggested that some standard method should be adopted.

7. *Frequency of Alternating Current Machinery.*—Mr. Rice said that alternators were being built in the United States for frequencies of 25, 30, 35, 40, 50, 60, 66, 125 and 133, and he suggested that three or four frequencies might be selected which would practically meet all requirements under the different conditions of generation, transmission and service, and that great advantages would accrue if it were possible to agree on such a limited number of standard frequencies.

In concluding his remarks, Mr. Rice laid much stress on the advisability of referring the question to a small committee of members, which would be instructed to confer with manufacturers, consulting engineers, and prominent users of electrical apparatus, and to report its recommendations to the Institute. The discussion which followed, and adjourned without any definite resolution being adopted, showed considerable divergence of opinion both as to what should be standardised, and as to the best way of dealing with the questions suggested for consideration; indeed, a great part of the time was spent in discussing the momentous question of whether manufacturers should or should not be admitted as members of the committee to which it was proposed to refer this question of standardising. The reason for objecting to manufacturers as members of the committee was apparently the fear that they would each have an axe of their own to grind, and that they would devote too much of their energies to this same grinding operation. It appears to us that consulting engineers, professors, and other non-manufacturing engineers will also have their special axes, and it does not seem fair to assume that one class is more likely than the other to try and use the committee for its own purposes, especially when it is borne in mind that the committee should be composed of the best men of each class. As the questions to be examined by the committee were the stricter definition of terms used in specifications and contracts, and the standardising of methods of testing, of rating of machines, and of frequencies of alternating current plant, all of them questions of great importance to the manufacturer; we certainly agree with Dr. Kennelly when he said in the course of the discussion that, "having a committee to recommend how manufacturers should make apparatus, without having any manufacturers on that committee, was something like playing Hamlet with Hamlet left out."

Although there were several speakers who thought that something might be done in the way of standardising types of apparatus, the general consensus of opinion was decidedly that any attempt by the committee at standardising apparatus would be a wrong policy. With this we entirely agree, as we consider that, with very few exceptions, the buyer's engineer should confine himself to defining what the apparatus has to do and how its capabilities of fulfilling the specified conditions will be verified, and that the construction of the machine should be left to the manufacturer. If this were done more in England, manufacturers would in their own interests standardise to a greater extent than they do now, and the buyer would undoubtedly benefit thereby, as machines would be made at less cost and more quickly than at present. Of course there always will be certain cases where the conditions of working will demand that a machine be designed specially to fulfil these requirements; but one finds too frequently that specifications for machines for ordinary lighting work are issued which demand that various details of the apparatus shall be constructed in a way which does not allow of the use of standard patterns. That this is so is to a great extent the fault of the manufacturers themselves, because they are so keen on getting the order that they do not make a sufficient difference in price between their standard apparatus and the one which embodies the alterations asked for; and we think that in this respect we might take a lesson from American manufacturers, who stick much more closely to their stock sizes, make these in large numbers, and, therefore, at reduced cost, and charge very considerable extras for any departure from their standard design.

With regard to the subjects enumerated by Mr. Rice, we think there is need also in this country for a better definition of terms and of methods of verifying whether electrical machinery fulfils the conditions laid down in the specifications. In the matter of efficiency, for example, although most specifications fix a commercial efficiency which has to be guaranteed, or require that the contractor shall fix it in his tender, very few state how it is to be measured; and anyone who has had practical experience of efficiency testing of belt-driven machines, knows that very varying results may be obtained by employing different methods of testing, such as the Swinburne method of measuring the stray power, and adding thereto the calculated C^2R losses; or the Hopkinson method of coupling two similar machines mechanically and electrically, and measuring the extra energy supplied to enable one machine to act as a motor and drive the other as a dynamo; or, again, the older way of trying to arrive at the efficiency of the dynamo by indicating the engine. Again, with regard to rise of temperature of the armature and magnet coils, we have the thermometer method, and the method of determining the rise of temperature by the increase of the conductor resistance, and these two methods give very different results. Each method has its advantages, and it does not matter much which is used, so long as the temperature limit is fixed in accordance with the method to be employed, and this method is clearly defined as is done, for example, in the Admiralty specification for dynamos. We know, however, of cases where the method of testing has not been specified, and the manufacturer has considered that his machine has fulfilled the conditions, whilst the receiving engineer has held that it was not to

specification, because one wanted to test with a thermometer and the other by conductor resistance.

The rating of the output of a direct-current dynamo, and the limits within which it should regulate, are also points deserving of attention, as we believe there are great variations in these respects between machines listed at the same output by different makers; and the buyer who wants a 200-light dynamo and gets quotations for its supply, often has nothing to tell him, whether the machine he buys will do its full load with a rise of temperature of, say, 60° F., and an increase of speed of 5 per cent. after a six hours' run, or with a rise of 80° or 90° F., and an increase of speed of perhaps 10 to 15 per cent.

Another point where greater uniformity would be an advantage is in the specification of insulation. In some cases it is specified that the insulation shall stand a breakdown test with a pressure which may be several times the working pressure, and in others a minimum resistance is fixed. In neither case does there appear to be any uniformity in the requirements—that is to say, that different engineers specify different ratios of testing pressure to working pressure; and whereas one specification will require an insulation resistance of half a megohm or less, another will ask for 5 megohms for machines working at the same voltage. If half a megohm is sufficient (and it may well happen that a machine having an insulation resistance less than that will stand a high pressure test better, and will be a more durable machine than one giving an insulation resistance of 5 megohms), it surely is unnecessarily increasing the price of the machine to insist that a manufacturer shall change his standard methods of insulation, so as to be able to get five megohms after carefully drying and cleaning all surfaces over which leakage may take place, and so putting the machine into a condition altogether different from that in which it ordinarily works.

The last point mentioned by Mr. Rice is the frequency of alternating current plant, and although we do not think that the frequencies used in this country vary so widely as appears to be the case in the United States, yet, as the differences which do exist are often found to be very inconvenient by makers of apparatus to be used on alternating current circuits, we think, as we have often said, that the fixing of certain standard frequencies would be advantageous, as it would enable such apparatus to be supplied more quickly and at lower costs.

There are, no doubt, other questions which will occur to our readers, such, for instance, as whether there is any serious advantage gained by the use of lamp voltages, which differ very little from one another, as, for example, 100, 110, and 115 volts, or the corresponding 200, 220 and 230 volts; but we do not propose to go further into the matter, as our object is not to discuss these various questions in detail, but rather to draw attention to what is taking place in America, and to invite our readers to consider whether it would not be to the advantage of the electrical industry if some similar steps were taken in England in the direction of fixing certain standard definitions and methods of testing; and even in some special cases of standardising apparatus, not by interfering in any way with the details of construction, but by agreeing to a more uniform specification with regard to voltage, frequency, and other kindred matters.

Telegraphy by Electric Oscillations.

Elenkonsky, in an article on "Telegraphy by Means of Electric Oscillations," which appears in the last issue of our Russian contemporary, *Elektrotechnik*, describes the progress realised since Hertz by Righi, Sarasin, De la Rive, Boltzmann, and Zender. He points out the influence of metallic powders on the electric waves, and tells us how, in 1890, Branly discovered his radio-conductor, and Lodge, after him, constructed his coherer, which is a kind of microphone. Branly demonstrated in 1890 that his radio-conductor can be used for revealing the electric waves, produced at a distance. Narkievitch Iodko had succeeded before Popoff in transmitting signals by means of a modified Lodge apparatus, at a distance of more than 2 kilometres. According to his articles in different papers, and to his letter to Ducretet, Popoff stated in the *Proceedings of the Russian Society of Physics and Chemistry* (December, 1895) that his apparatus can be utilised for transmitting signals by means of rapid electric oscillations when a sufficiently strong discharger of these oscillations is available. When Marconi made public his discovery, Popoff, in the journal *Kotlin*, declared that he had already succeeded in transmitting signals on land at a distance of one nautical mile and on sea at three miles. Therefore, the conclusion is:—1st, that Marconi utilised for his apparatus the principles discovered by other experimenters; 2nd, that before Marconi, many experimenters had demonstrated the possible adaptation of the electric vibrations to the transmission of signals. No one will assert that Branly, Lodge, and Popoff would not have been able to find the practical solution of the problem if they had taken the subject in hand, and if they had *believed* in the practical future of telegraphy by means of electric vibrations. Marconi's merit is that he *believed* in the future of wireless telegraphy, and that in view of this practical object, he developed and simplified apparatus which, until then, had only been employed for theoretical work.

Economy Test of a Central Station.—Before the American Institute of Electrical Engineers, Prof. Goldsborough, of Purdue University, read a paper on the economy test of the West Pratt Street station of the Edison Electric Illuminating Company, of Baltimore, Ind. The paper is abstracted in the *Electrical World*. "While the station is not by any means a model up-to-date one, it is perhaps representative of the average lighting station of gradual growth and moderate size. The engine equipment, for example, consists of one 600-H.P. horizontal cross-compound Ball & Wood engine, one high speed Russell simple engine of 170 horse-power, one of 125 horse-power, one 300-H.P. tandem-compound Ideal engine, one 300-H.P. cross-compound Ball & Wood engine, two 145-H.P. Buckeye engines, and one 300-H.P. Ide engine. The generators are series arc and 1,000-volt alternating machines of as wide a range of makes and sizes, all being belted machines. The tests were most complete, and some of their results are of interest, in that they show the low economy to be expected of such a heterogeneous equipment. The boiler tests showed that the equivalent water evaporated per pound of combustible from and at 212° Fahr., varied from 6·83 lbs. to 12 lbs., averaging between 8 and 9 lbs. The all-day efficiency of the plant or ratio of the electrical horse-power at the switchboard to the indicated horse-power at the engines was found to be about 68 per cent., which is commented upon as 'excellent, in showing that the station is operated far more efficiently than could be expected, when the numerous drawbacks which have to be contended with are remembered.' The electrical output per pound of coal is given for one test as 150·5 watt-hours, and for another test as 157·3. This figure is compared with the data given in the report of the committee of the National Electric Light Association in 1896, in which the average efficiency of 81 stations, using coal as fuel, was given as 108 watt-hours per pound of coal."

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THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the meeting of the Institution of Electrical Engineers held on the 12th inst. at the Society of Arts, Prof. Ewing gave a summary of his paper on "A Magnetic Balance for Workshop Tests of Permeability," and exhibited the apparatus in use. After the discussion on this paper closed, Mr. A. H. Gibbings, borough electrical engineer of Bradford, described the supply meter, based on the decomposition of an aqueous acidified electrolyte, which formed the subject of his paper on "The Registration of Small Currents Used for Electric Lighting or other Purposes."

Prof. Ayrton opened the discussion on Prof. Ewing's paper, and congratulated the writer on the many ingenious instruments he had devised for electrical measurements. The speaker was surprised to find that the magnetic balance had so open a scale for so small a range with the same magnetising force. In the paper it was stated that "the range of the balance extends (for H = 20) from 12,000 up to something over 16,000. He would have thought the instrument would have been less sensitive, and therefore less valuable, and would like to know the actual force of detachment employed for a given position, also how the actual force (H) is divided up. Lastly, it would be interesting to be informed how far there is risk of error being introduced from the presence of dirt, &c., at the point of contact between the specimen and the magnet pole; as there are curved surfaces the reluctance may be small. The interesting question is the kind of error—how far a slight trace of oil or dirt would interfere with the accuracy of the instrument, which seemed to be, from the experiments shown, very great.

Prof. Perry remarked that he understood Prof. Ewing was satisfied, and that we were told an accuracy of 1 per cent. could be obtained. The speaker should hardly have expected such accuracy. Throughout the discussion the feeling was prevalent that what Prof. Ewing considered could be obtained from the balance would be got; the invention of such an able and illustrious worker in magnetics being certain to prove accurate and highly useful. This was the tone in which Prof. S. P. Thompson spoke when joining in the congratulations to the author: "If Prof. Ewing is satisfied, no one else ought to be dissatisfied." Long ago Prof. Thompson had devised the permeameter, and he felt gratified that Prof. Ewing was now converted to traction methods, the instrument before the meeting being a much better and more refined apparatus than others working on similar principles. He would return another compliment paid him when placing his instrument before the public—namely, criticise the balance. The criticism originally was that he ought to have cut the bar in the permeameter in the middle; he had placed the contact right outside. To make the contact on the top of a projecting pole-piece, however, certainly surpassed Prof. Thompson! Again, in the permeameter a faced joint was required, but the reluctance of the lead joint was so small it made no perceptible difference, and Prof. Ewing had again gone one better. Whether by such a very small contact—that between the side of a turned bar ¼ inch in diameter and a pole having a slightly convex surface, the side of the rod touching the pole at one point only—there would not be some error due to gathering of the magnetic flux was a question.

Prof. Ewing has taken the value of the force H as 20. Prof. Thompson supposed it was good to have a fixed value; the instrument does not pretend to give points along the magnetic curve, but one frequently wants values in other fields than one, and in large multipolar machines B is often lower than 13,000 and the fields are lower than 20, while in the teeth of core discs B runs up to 20,000, far beyond the limits of this instrument at the upper end. The last and only other point Prof. Thompson made was that he wished he could induce Prof. Ewing to use Clarendon type. This brought Prof. Perry to his feet with an emphatic protest against the use of Clarendon type, and the expression of a pious hope that Prof. Ewing would do nothing of the sort.

Mr. Mordey was glad to see how Prof. Ewing was adding practical instructions to valuable theoretical work, and desired to direct attention to iron testing in bulk. He thought the instrument shown that evening was one of the simplest and best, but what one wants is to take a big casting and make a test of its magnetic quality before it goes in the tools; cutting a piece out of it may affect the character of the sample; he asked Prof. Ewing to increase our indebtedness to him by enabling us to test iron in bulk. Cast-iron varies enormously in its magnetic qualities. Identical machines may vary 70 per cent. in exciting current, and such differences are very serious indeed when a strict specification has to be complied with. He wanted to know whether it was necessary to be particular as to the time the current was on, or the time taken to detect the best piece in the balance.

He would say we should get out an instrument that would enable one to order iron and steel of certain definite magnetic qualities and pay for what is got, and not for what makers like to give one. When he started making transformers Swedish iron was very good, but afterwards iron all over the world got very much worse with some very uncomfortable results; orders were accepted which stipulated for a certain loss, but iron got poorer in quality, the losses went up, and makers were penalised heavily through no fault of their own. He had advised that material should be ordered of a certain magnetic quality, but makers did not like the specification at first; in six months, however, the result was that the quality crept up, and came within 5 per cent. of the specification, owing to a penalty and bonus clause giving in shillings per cwt. an allowance for the losses (in watts per pound) due to magnetic qualities. He thought if one could specify iron for magnets in any way like that a very great service would be rendered.

Mr. Swinburne pointed out that the mistake with some forms of traction instruments for magnetic testing was that the pull would be too high if any unevenness existed at the contact. Obviously, the contact is more highly saturated than anywhere else, and there is thus the chance of a pretty big error. Prof. Ayrton interpolated the remark that this was the whole interest of the apparatus before the meeting, within its range this crowding together compensated for the variation in the distribution of the magnetising force in the circuit. That is not what one would have expected *à priori*. Mr. Evershed thought that the natural criticism of the balance had been very well put by Mr. Mordey.

In his reply Prof. Ewing said that Prof. Ayrton had commented upon the comparatively large range of scale, the large preponderance of force was due to the beam of the balance itself, and the weight served to make small differences. The magneto-motive force is no doubt mainly used to overcome the reluctance of the specimen at the point of contact, and there is great crowding, therefore the instrument might not serve very well to make tests with low values of magneto-motive force. As things are, one has a force which is high in the specimen itself. What one has is a force of 20 on most of the specimen and a force very much higher than 20 at the contact; but if the bar has good permeability for one of these points it will be relatively good at others. Prof. Ewing deprecated the determination of B in absolute methods except by ballistic determination. All he did was to use a traction method to compare two bars, one of which had been carefully tested ballistically. It was true that points on the B H curve were not obtained; if such were wanted, his permeability bridge was distinctly the instrument to be employed. There was no difficulty in wiping the contact clean. He closed with some remarks on the increase in magnetic losses of sheet iron due to continued use in a variable magnetic field.

Mr. Gibbings then gave a description of the electrolytic meter devised by Mr. Bastian, which was the subject of an article in the Electrical Review of the 13th inst. Mr. Evershed was at a loss to know how far he could praise this meter, being interested in a meter of his own. He had expressed a desire to see a meter that could be made for 40s. or 50s. (see remarks by Mr. Evershed, *Municipal Electrical Association Proceedings*, 1897, p. 64, and reprint in Mr. Gibbings's paper). The principal question was how long this meter was going to last. One and all electrolytic meters had failed from causes difficult to trace, generally, however, the end was a general disintegration of the electrodes. Another criticism was as regards evaporation of the water. Although oil had been used on the surface of acid in accumulators, he had found that this did not get rid of spray. The large drop in volts was not so serious as one would expect, being only ½ per cent. from no load to full load. The

nearly all the energy is spent in heating conductors. He had found that in well known types only $\frac{1}{300}$th of the total power went to drive the gear, the rest was wasted in heating, so that in the motor-meter one has an absurdly inefficient means of integration. Then materials necessarily cost a lot, a thermometer could be sold for 1s. 6d., but as one must have a considerable amount of copper to get losses down to a reasonable amount a meter must be costly. Gas meters were relatively efficient and fairly accurate, whereas the Hookham meter absorbs 5 and the Thomson 12 watts. Some interesting but rather irrelevant figures as to gas meters were then given, which it is unnecessary to reproduce.

Mr. Swinburne had been accused of having tried to make every kind of meter, but none would work; he *had* got a meter that worked, however, although someone else had patented it before him. One's first inclination in discussing a matter of this kind is to say, "Oh! that was done years ago." He replied: "Don't believe it." Every crude idea is not an invention; any fool can make an invention; it takes a clever man to work out the details, and a genius to sell it!

Mr. Arthur Wright thanked Mr. Gibbings for bringing before them a meter which will help to sell their product. The efficiency of a meter never seems to occur to his friends in central stations; the question is, will it register? and does it cost very much to keep in order? He had heard that the question of the volt-drop was immaterial; it seemed to him that the objection was that 1 per cent. of the station output was wasted in making gas.

Mr. Hirst had had a good deal of experience with central station engineers, and found they looked at the cost of maintenance closely. He thought the use of oil on the top of the water would mean cleaning frequently, and that the refilling meant the loss of previous readings. Every meter maker felt the want of a small meter for small consumers. The Board of Trade had insisted upon unnecessary accuracy in electricity, as compared with gas meters. Then as to the lost or wasted power; this had been mentioned as 10 to 12 or 15 watts. He knew of a meter—whose name need not be given—which only required 1 watt. The audience fully realised the force of Mr. Hirst's argument, and whence it was directed. Mr. J. W. Swan thought the meter well deserved a trial.

Mr. Gibbings, in his reply, stated that six months' experience of the meter had been obtained. He attributed the avoidance of error to the small surface exposed to evaporation, and considered the great merit of the apparatus to be the certainty of registration with small C.P. lamps on "high voltage" circuits.

UNIVERSAL SHUNT.

By J. RYMER-JONES.

In the Electrical Review of April 10th, 1896, p. 467, is a description and illustration of a convenient adjustable "universal" shunt, with a X power of any value from 1 to 10,000; and which when not required for a shunt can be employed for all tests, based on the "Fall of potential" principle, for which the Kelvin-Varley slides are applicable.

Although this form of shunt leaves nothing to be desired in point of convenience, and has been employed during the last two years for testing cable in the factory with very satisfactory results, yet owing to the cost being an important consideration, the writer has lately turned his attention again to the subject, with a view to including the slide proper and the so-called *vernier* slide in one box, and at the same time considerably reducing the price of construction. The present object, however, in again referring to the above subject, is not so much to draw attention to simplification effected, as to point out and correct an error when speaking of the K-V slides as not being applicable for a *universal* shunt.

Although shunting two of the *main* coils r_2 of the K-V slides with 100 *vernier* coils $x + y$—the sum of which latter gives an equal resistance—produces a *fall of potential* in these two parallel circuits equal to that in one of the main coils, so that a sliding contact on the *vernier* branch (divided into 100 parts) gives the potential at each of the subdivisions (figs. 1 and 2), yet it appeared at first sight equally evident that, while suitable for *potentials*, the conditions would be entirely changed if employed as a universal shunt; *i.e.*, for a continuous current flowing through the system; and that not only would the resistance *permanently* shunting

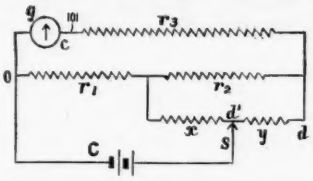


Fig. 1.

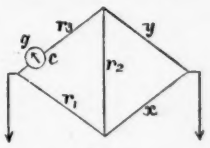


Fig. 2.

the galvanometer vary somewhat—when, for instance, the the vernier contact s is at d to when it is at d' or some other intermediate point—but that the X power of the shunt would not be strictly proportional to the scale reading.

To ascertain what the difference actually was, the writer calculated the current c passing through the galvanometer for various positions of the vernier contact when shunting different parts of the main resistance by the following formula obtained from the laws of dynamic electric circuits:—

$$c = \frac{r_1\,(x+y+r_2) + x\,r_2}{(x+y+r_2)\,(r_3+g) + r_1\,(x+y+r_2) + r_2\,(x+y)}\,\mathrm{C}, \text{ or}$$

$$\frac{r_1\,(y+r_2) + x\,(r_1+r_2)}{(r_1+r_3+g)\,(x+y) + r_2\,(r_1+r_3+y+x+y)}\,\mathrm{C},$$

where $r_1 + r_2 + r_3 = 1{,}100^{\omega}$ = total resistance of the *slides* proper; r_2 = two coils of 100^{ω} each = 200^{ω}; $x + y = 100$ vernier coils of 2^{ω} each; $g = 1{,}200^{\omega}$; C = current from battery; c = current through galvanometer.

It was no little surprise to find that the calculated X powers are in every case identical to the values obtained with the ordinary simple univeral shunt as shown by the following examples:—

(1) Slide reading = 10,000, *i.e.*, $r_1 = 9{,}900$, $r_3 = 0$, $x = 200$, and $y = 0$.

				X power ratio.
$y + r_2$	= 200	$200\,r_1$	= 1,980,000	
$r_1 + r_2$	= 10,100	$10{,}100\,x$	= 2,020,000	
			4,000,000	
$x + y$	= 200			
$r_1 + r_3 + g$	= 11,100	$11{,}100\,(x+y)$	= 2,220,000	
$r_1 + r_3 + g + x + y$	= 11,300	$11{,}300\,r_2$	= 2,260,000	
			4,480,000	

$$c = \frac{4{,}000{,}000}{4{,}480{,}000} = \frac{1}{1{\cdot}12}\,\mathrm{C} \qquad 1$$

(2) Slide reading = 100, *i.e.*, $r_1 = 0$, $r_3 = 9{,}900$, $x = 200$, and $y = 0$.

$y + r_2$	= 200	$200\,r_1$	= 0	
$r_1 + r_2$	= 200	$200\,x$	= 40,000	
$x + y$	= 200			
$r_1 + r_3 + g$	= 11,100	$11{,}100\,(x+y)$	= 2,220,000	
$r_1 + r_3 + g + x + y$	= 11,300	$11{,}300\,r_2$	= 2,260,000	
			4,480,000	

$$c = \frac{40{,}000}{4{,}480{,}000} = \frac{1}{112}\,\mathrm{C} \qquad 100$$

(3) Slide reading = 1, *i.e.*, $r_1 = 0$, $r_3 = 9{,}900$, $x = 2$, and $y = 198$.

$y + r_2$	= 398	$398\,r_1$	= 0	
$r_1 + r_2$	= 200	$200\,x$	= 400	
$x + y$	= 200			
$r_1 + r_3 + g$	= 11,100	$11{,}100\,(x+y)$	= 2,220,000	
$r_1 + r_3 + g + x + y$	= 11,300	$11{,}300\,r_2$	= 2,260,000	
			4,480,000	

$$c = \frac{400}{4{,}480{,}000} = \frac{1}{11{,}200}\,\mathrm{C} \qquad 10{,}000$$

Investigating the subject more closely, the following consideration clearly proves that the two arrangements of shunt are equally correct.

Referring to the examples worked out with the above formula for a K-V form of shunt, it will be seen that the efficiency of a meter was low; consider a motor-meter,

denominator is a constant value for all positions of the slide contact; so that the current through the galvanometer is always proportional to $r_1 (x + y + r_3) + x r_3$; in which $x + y = r_2$, viz., a constant value of 200, or $2 r_1 r_2 + x r_2$, *i.e.*, $2 r_2 \left(r_1 + \frac{x}{2}\right)$, or $400 \left(r_1 + \frac{x}{2}\right)$.

For the ordinary simple universal shunt (fig. 3) where each coil has a resistance equal to two of the K-V coils (r_2) *when*

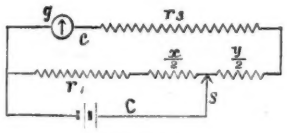


Fig. 3.

shunted with an equivalent resistance in the vernier coils $(x + y)$—that is only half their combined resistance *without* this parallel circuit—the two portions on either side of the contact *s* may be represented by respectively $\frac{x}{2}$ and $\frac{y}{2}$.

In this arrangement $r_1 + \frac{x}{2} + \frac{y}{2} + r_3 = 10{,}000^{\omega}$; and $\frac{x}{2} + \frac{y}{2} = 100$ vernier coils of 1^{ω} each.

For such a simple shunted galvanometer circuit, the fractional value *c* of the current passing through the galvanometer for any position of the slide contact is proportional to the shunt resistance, viz.:—

$$\frac{c}{C} = \frac{r_1 + \frac{x}{2}}{r_1 + r_3 + g + \frac{x}{2} + \frac{y}{2}}$$

[in which the denominator has a *constant* value].

Hence the current *c* through the galvanometer is also proportional to $r_1 + \frac{x}{2}$ as when the K-V slides are employed.

As the resistance of the *ordinary* K-V slides ($100{,}000^{\omega}$) is, however, undesirably high for a universal shunt, it is preferable to reduce the resistance of all coils to $\frac{1}{10}$th of their usual value; viz., to a total of $10{,}000^{\omega}$, as for the examples worked out above.

Fig. 4 shows a modified form of K-V slides in which 101 coils of 100^{ω} each are arranged around the circumference of the central *vernier* slide having 100 coils of 2^{ω} each. The former are fixed and the latter can be moved bodily round on the circular ebonite slab to which they are attached,

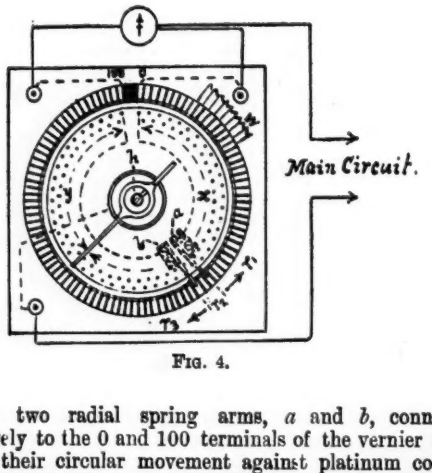


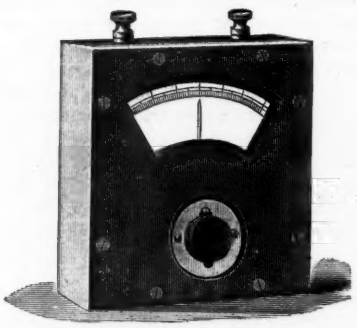
Fig. 4.

so that two radial spring arms, *a* and *b*, connected respectively to the 0 and 100 terminals of the vernier coils, press in their circular movement against platinum contact wires affixed to the top surface of the 101 segmental pieces to which the main resistance bobbins, as shown at W, are connected, and shunt *two* of them with an equal resistance (200^{ω}) in the same manner as the K-V slides provide for.

The *vernier* slab is moved round by a central handle, *h* (the *vernier* contact meanwhile remaining on its zero stud) until the two radial spring contacts, *a* and *b*, reach a position which gives an approximately suitable shunt value, which can be more exactly adjusted, if necessary, by the vernier slide contact. This is moved round by the same handle, because the detent which before clamped it to the spindle rising from the centre of the ebonite slab is now withdrawn, so as to allow the vernier contact spring to be moved round freely without altering the position of *a* and *b*. Thus if 3,526 be the full shunt reading, 35 will be read off the brass segments outside and 26 on the vernier scale. The amount of friction with which the vernier slab moves round can be regulated by screws from outside the case.

DEAD-BEAT SENSITIVE INDICATING GALVANOMETER.

The want of a dead-beat sensitive *indicating* galvanometer has for some time been felt. There are so many purposes to which it could be put both in experimental and practical work, that the introduction of a cheap reliable instrument of this nature has become a necessity, therefore Messrs. Crompton, who have for some years past manufactured for use in their laboratory at Kensington Court, and to order, an instrument of the D'Arsonval or moving coil type, have



now decided to place it upon the market at a reasonable price. The instrument is as illustrated herewith, and can be supplied to any reasonable degree of sensibility, that usual with an instrument of 200 to 300 ohms resistance being a deflection of 1·75 millimetres with $\frac{1}{1000}$th of a volt applied to its terminals.

The same type of instrument can be supplied divided off as a milli-voltmeter or ammeter, so that by means of suitable shunts the instrument becomes direct reading in the matter of amperes or volts, or it can be calibrated direct as a low reading volt or amperemeter, its absolute dead-beatness enabling very fast work to be done. It is in this latter respect admirably suited as a "cell volt tester," in which case the zero is placed in the centre of the scale so that readings may be taken either side, so obviating the necessity of a reversing key.

ELECTRIC RAILWAY MOTORS.

It seems that the subject of Prof. Carus-Wilson's paper, on "The Design of Electric Railway Motors for Rapid Acceleration," has not been treated very rigorously from the experienced electrical tramway engineer's point of view.

In the first place the torque can be more conveniently expressed by the magnetic flux per pole, times the number of current turns opposite pole; this multiplied by the number of poles gives the total torque of the armature.

In the designing of motors for rapid acceleration it has been found necessary to get out a set of diagrams showing exactly the total effort required to produce a good accelera-

tion, and have then designed a motor with proper torque to give this acceleration.

It does not appear that the question of the fly-wheel effect on the armature and driving wheels has been considered in determining the total starting effort. For rapid acceleration it is of the utmost importance that the moment of inertia of the armature and driving wheels be limited to the smallest possible amount. For this reason best traction practice has been directed towards diminishing the diameter of the armature. The first single reduction motors were built with an armature of 18 inches diameter, whereas at the present time motors of the same capacity have an armature of 10 inches in diameter, so that the effort to start the armature itself and the rotation has been tremendously diminished.

Another point we should have liked to see discussed in the paper is the difference between saturated and non-saturated motors for rapid acceleration. The saturated motor acts very much like a shunt motor, consequently the torque varies approximately with the current; whereas, with a non-saturated motor the torque varies approximately with the square of the current. Obviously then, for very rapid acceleration the degree of magnetisation has to be carefully considered.

Most traction motors built to this time have been very highly saturated, but this was brought about primarily from consideration of weight. When, however, such high accelerations as 2 or 3 feet per second have to be considered, it is found that the non-saturated motor, on account of its greater efficiency, gives greater acceleration for the same weight.

The paper will probably be of some interest to many members of the Institution, but those particularly interested in electric traction will, no doubt, expect a more rigorous treatment of the subject.

ALUMINIUM AND OTHER ELECTRO-CHEMICAL INDUSTRIES AT FOYERS.

A SPECIAL meeting was convened a few weeks ago by the London section of the Society of Chemical Industry for the purpose of receiving a paper by R. W. Wallace, Esq., Q.C., on the work that has been done by the British Aluminium Company at Foyers. Much of the information given in this paper is old news to most of our readers,* but it is all well and carefully put, Mr. Wallace by no means erring on the side of exaggeration; and a study of the paper cannot fail to be instructive as well as suggestive.

From our special point of view, perhaps the most important result of the operations at Foyers is that contained in Mr. Wallace's statement that the British Aluminium Company is able to produce electrical energy, including all costs and interest on capital, at less than one-third the cost that the same could be produced by coal and steam. To demonstrate this is an achievement of great significance, for not only will it enable many manufactures to be carried on under remunerative conditions, but it will attract capitalists to the exploiting of natural sources of power now running to waste, and result without doubt in their utilisation. The successes which have been achieved at Foyers will give a great impetus to electrical engineering generally.

Remembering that his audience was chiefly composed of chemists, Mr. Wallace touched rather lightly upon the engineering aspects of the industry at Foyers, and mainly concerned himself with an account of the electro-chemical industries which are carried on there. He discussed the history of aluminium at some length, comparing the various methods which have been from time to time proposed and worked. The process used at Foyers was carefully explained. Our readers are familiar with this, so we need not follow his description of it; we may note, however, his statement that the practical yield is 1 lb. of aluminium metal per 12 E.H.P. hours.

The aluminium industry is one of the most remarkable of modern times as regards rapid development. Just 12 years ago the total output of the whole world was about 5 tons. Even as late as 1890 only 40 tons were produced, and the price was £1,083 per ton. Last year 2,500 tons were produced, and the price was £148 per ton.

Mr. Wallace claims that the aluminium produced at Foyers is practically pure, though a large quantity is produced of a somewhat lower grade, namely, containing 98·5 99·0 per cent. of aluminium. The various chemical and physical properties of the metal were of course described, and amongst these we may notice that Lord Kelvin's latest results for the electrical resistance of aluminium (99 69 per cent. pure) show $6{\cdot}997 + 10^{-6}$ Board of Trade ohms per gramme-length (*i.e.*, for a length of wire weighing 1 gramme) at 0° C.; or 2 58 microhms per cubic centimetre. Taking Dewar's value for pure copper ($1{\cdot}563 + 10^{-6}$ Board of Trade ohms at 0° C.), the relative resistance of the aluminium becomes 165·3 per cent.; that is to say, its conductivity, volume for volume, is 60·5 per cent., and, weight for weight, double that of copper.

Mr. Wallace entered very carefully into the subject of the materials used in the industry, and defended the company against the charge of their having been unwise in their selection, not only of materials, but of the sites of some of their various works. He divided the various uses of aluminium into three general classes, pointing out that it may be employed alone, as an ingredient in alloys, and as a metallurgical re-agent in the purification of other metals.

At Foyers carbide of calcium is now made, and there is plenty of spare horse-power which may be utilised in the production of cyanides, chlorate of potash, sodium, caustic soda, carborundum, &c., not to mention phosphorus, the manufacture of which has left this country to go to Niagara. These and other processes require for their chemical success the use of cheap electrical energy. The cost of the power to produce this energy is the all important factor, and the experience of the British Aluminium Company gained from the development of the water-power in Foyers, proves that this power costs but a fraction of that produced from coal or any other known source. This statement did not pass without challenge in the discussion which followed, when one speaker pointed out that it had recently been claimed at a meeting of the Institution of Civil Engineers, that at the present price of coal in this country, it was possible, near the pits, to produce power cheaper than by water. Mr. Wallace replied very carefully to those who took part in the discussion, and stated that, with regard to the cost of producing electrical energy from coal and steam-power *versus* water, he could only say that, roughly speaking, the cost per horse-power at Foyers was about 30s. per annum, exclusive of interest on capital, whilst Prof. Kennedy had put the lowest price for producing it in Scotland, coal costing 3s. 6d. per ton, at £9 per horse-power per annum.

Mr. Wallace's paper certainly forms an extremely interesting *resumé* of work done in a new direction, which marks an epoch in the history of electrical enterprise in this country.

* See ELECTRICAL REVIEW for May 14th, 1897.

SOCIÉTÉ INTERNATIONALE DES ELECTRICIENS.

MONTHLY SITTING.

THE monthly sitting of the Société des Electriciens was held on May 4th, M. R. V. Picou then entering upon his duties as president. After the reading of the report, M. Picou made his speech. He promised to work for the good of the society, and spoke in praise of his predecessor, Dr. d'Arsonval.

M. LAPORTE then gave the results of some experiments which he had performed at the Central Electrical Laboratory on photometric standards. He studied first the Violle standard, and then the Carcel standard, and found that a decimal candle is equivalent to ·104 Carcel. He received some lamps standardised at the Electro-technical Institute of Berlin, and standardised them again himself. The results were as follows:—

	Electro-technical Institute.		Central Laboratory.	
	I.	II.	I.	II.
Difference of potential in volts ...	108 5	111 5	108·5	111
Amperes	·338	·489	·338	·487
Luminous intensity	10 hefner	16	8 7 candles	14·2

He then made various experiments on the Hefner and Carcel lamps and on the paraffin candle; he then compared the same incandescence

lamp with a special standard, A, with a Carcel, with a Hefner, and with a paraffin candle, and found:—

·194 A
·341 Carcel
·72 Hefner
3·13 paraffin candle.

M. P. Gibault then read a paper on "Commutation in Continuous Current Dynamos." He brought forward with regard to this question a series of somewhat intricate calculations which we cannot particularise here.

THE TELEPHONE INQUIRY.

The Select Committee of the House of Commons appointed to inquire into and report upon the question of the acquisition of the telephone service by municipal authorities, sat for the first time on Tuesday of last week for the purpose of taking evidence, Mr. Hanbury, secretary to the Treasury, presiding. The inquiries of the Committee are to be directed more particularly to the question as to whether the telephone service is, or is calculated to become, of such general benefit as to justify its being undertaken by municipal and other local authorities, regard being had to local finance; and if so, whether they should have power to undertake such service in the districts of other local authorities outside the area of their own jurisdiction, but comprised wholly or partially in the same telephone area, and what powers, duties, and obligations ought to be conferred or imposed upon such local authorities.

Sir Robert Hunter, solicitor to the Post Office, was the first witness, his evidence continuing throughout the whole of the sitting. Examined by the Chairman, he gave a history of the dealings of the Post Office with the various telephone companies. He said that in 1880 the Postmaster was advised that spoken communications by telephone were to be regarded as telegrams within the meaning of the Act, and an action was commenced—"The Attorney-General *v.* The Edison Telephone Company." In that suit it was decided that every organised system of communication by means of electricity, and any communication by means of wires, according to a preconcerted system of signals, was within the Act of 1869, and that telephones came within the monopoly enjoyed by the Post Office, and that every telephonic communication was a telegram. Immediately after that decision, licenses were granted to various companies by the Postmaster-General. The system at first was to grant a separate license for every district, but those licenses were only granted to a comparatively few companies. There was a limitation as to the distance through which telegrams should be sent. That system lasted until 1884. The licenses reserved the right of the Postmaster to compete within these districts, and no kind of monopoly had ever been granted by them. The companies had no special wayleaves, and had to take their chance with regard to them. Licenses were also granted for trunk wires. In 1884 representations were made as to the hardship of these restricted licenses, and it was then decided that all licenses should in future be general in their character, and should enable any body to whom they were granted to transmit telephonic communications anywhere within the United Kingdom. The consideration had always been that 10 per cent. of the gross receipts should be paid to the Post Office. In 1892 the Government announced another change of policy. After 1884 the telephone companies became gradually amalgamated, and at the beginning of 1892 practically all the telephone business of the country, both exchange and trunk wire, were in the hands of the National Telephone Company. It was not the only company in existence, but the others were comparatively very small. No limitation was imposed by Government such as that on gas and water companies. The telephone companies could make any charge they liked, and they could supply whom they liked, as opposed to the legislation with regard to the gas and water companies, which allowed only such charges to be made as were settled by Act of Parliament, and required that if a company raised its dividend it should lower its charges. There were no such limitations with respect to the telephone companies. On the other hand, the gas and water companies had specific powers for opening streets independently of the consent of the local authorities, which was not the case with the telephone companies. If the owner of a house refused to have a pole placed upon his property he thought the telephone company could refuse to serve him. In 1892 an arrangement was come to with the National Telephone Company and the New Company. The general principle of that arrangement was that the Post Office should take into its hands all the trunk wires and leave in the hands of the companies all the exchanges within areas. That policy was recognised by Parliament by the Telegram Act of 1892. The areas were composed originally of urban districts, and in addition there were tracts of country in connection with the urban districts where the telephone company had been carrying on business, and these were embodied in the deed. The next step was that the National Telephone Company sold to the Postmaster-General all the trunk wires outside certain areas, £459,000 being paid. By this arrangement the trunk messages practically came into the hands of the Government, the National Telephone Company having still the right to send messages within the exchange districts. They also had the right to telephone messages to the Post Office which were written down and sent as telegrams. If there was any recognised delay on the part of the telephone company in sending a message which came off the Post Office wires it would be a breach of their agreement with the Post Office, and the Post Office would have the right to remonstrate with the telephone company and to state what the remedy was. That would be a matter for grave consideration. He should think the National Telephone Company would say that there never was any undue delay. There was no proviso as to delivering a message within a specified time. If the telephone company put any difficulty in the way of the free use of their wires in connection with the Post Office that would be a breach of the agreement of 1892, and he had no doubt the Post Office would find a remedy.

The Chairman: It might occur all the same that the company would prefer to give precedence to a message sent by one of their own subscribers.

Witness said that would be a breach of their agreement. He thought it would be very difficult to frame a provision which would prevent a company in competition with the National Telephone Company from amalgamating with it or of being acquired by it. The New Company went into liquidation, and he thought he was right in saying that the secretary of the National Telephone Company was the liquidator. Originally it had been contemplated that the New Company should have precisely the same agreement with the Post Office as the National Telephone Company, but as the New Company was in *articulis mortis*, and were expected to surrender their agreement, they were informed that the Post Office would not interfere with their business in certain towns, as it would gradually die out. When Mr. Raikes was Postmaster he had a very strong feeling against the companies combining, and was very anxious to keep up competition amongst the various companies, but he found he could not prevent the amalgamation. There was a very strong feeling on the part of Mr. Raikes that these amalgamations ought not to be permitted. In 1892 the principle was laid down that fresh licenses should not be granted substantially without the support of the municipal bodies. Up till then licenses had been granted freely without difficulty. In Mr. Raikes's time opinion was taken as to whether the Post Office could prevent the amalgamations, and they were advised that they could not do so. With regard to competition, the Postmaster-General was perfectly at liberty to establish competition in any exchange area, and he was perfectly free to grant licenses to any other body in any area.

The Chairman: We have got the fact that the company has no limit to its rights, and there is no provision as to any preferential rights.

Witness said that was so. The National Telephone Company's rights terminated on December 31st, 1910. On that date their rights terminated and they had no business to dispose of.

Assuming that the year 1911 is reached and the Government had not bought up the company, what is the position of the National Telephone Company in the face of the Post Office?—In the first place the license absolutely lapses.

Is the Postmaster under obligation to buy any portion of the plant?—None whatever, and on the other hand there is no power of buying it compulsorily; the two parties are absolutely like ordinary persons, two parties to a bargain.

In 1911 the license will have ceased. The National Telephone Company could no longer send messages and therefore could not use its plant.—Quite so.

The only person who could buy the plant to put it to any probable use would be the Government, and they are not under obligation to buy any portion of it?—Not the least.

Witness continuing, said the Postmaster-General had power to purchase the business of the National Telephone Company in 1904, provided he gave notice of that purchase, and in the case of difference as to the price the matter was to be determined by arbitration. In the agreement of 1896 there was a special provision that it should terminate at the same time as the original license, and upon the purchase any additional powers derived under the agreement of 1896 shall not be property to be purchased by the Postmaster-General. The Postmaster-General derived his wayleaves power from various Acts. He had power to place his telegraphs either over or under roads with the consent of the local authorities. If the local authorities refused such consent, there was an appeal to the police magistrates, or the justices, and a further appeal to the High Court. This provision applied all over the country, England, Scotland and Ireland. The Postmaster-General always objected strongly to paying any rent for poles. Of course, in the case of private property, the Post Office was in the hands of the owner, and if he would not let them place the poles on his property, they could not do it. They could put up telegraphs on a public road in the country without the consent of the local authority, but in other places the consent of the local authority was necessary. Speaking generally, the Post Office could not make any attachment of wires or erect posts on private property without the consent of the owner. In the country they could not take a wire over private property without the consent of the owner, but in towns, when the Post Office had obtained the consent of the road authority for carrying wires along the street, then they could carry the wires over the property of private owners. The Post Office had an exclusive wayleave over most of the important lines of railway, and also over the canals. Over some lines of railway the Post Office had a wayleave, but it was not exclusive. The telephone companies had no right over the railways, or over private property, except that, assuming they had attachments on opposite sides of the road, they could carry their wires over without the consent of the local authority, provided they did not interfere with the use of the road. If they had the consent of the local authority, they could not then use the roads. It was the law that no obstruction could be made in the road, even with the consent of the local authority, except under Act of Parliament. It had been decided that the erection of poles upon the greensward at the side of the road, even with the consent of the local authority, was not permissible except under Act of Parliament. Up to 1892 there ought not to have been any wires laid under the ground by the company. Strictly speaking, there ought not to have been any over-

head wires either, though he believed there were. Before 1892 they had practically no wayleaves at all, except over private property with the consent of the owner. In 1892 they got certain rights of wayleaves. It was part of the arrangement that the Postmaster-General should be empowered to grant his license to exercise the same powers he had. There was no special consideration of this; it was part of the arrangement as to the trunk wires and exchange areas. In 1892 the Act was passed authorising the Postmaster-General to give the companies wayleaves, but they had no authority to exercise wayleave power until 1896. The Act referred not merely to the National Telephone Company but to all licensees. The National Telephone Company on more than one occasion endeavoured to obtain wayleaves from Parliament before 1892, and these Bills were opposed by the Postmaster-General on the ground that it was not desirable licensees of his should have an independent statutory provision. The powers the National Telephone Company applied for were really stronger than any the Postmaster-General had. The National Telephone Company could not exercise any wayleave powers except under the special license of the Postmaster-General.

What are the powers which the Postmaster-General is authorised to give to the National Telephone Company, or any other company?—Just the same powers as regarded roads, buildings, and towns, and so on, as he himself possessed, but these powers were qualified by provisos. The fact was, that the powers the Postmaster-General gave could only be exercised in an urban sanitary district or such area adjoining as was prescribed in the license. The second proviso was that the licensee should not exercise any power without the consent of the County Council, or other authority, and should be subject to such terms as they might exact. Another condition of the Act was that the Postmaster-General should not give any wayleave powers over the railways or canals. The Postmaster-General was under contract to give the National Telephone Company all he could give under the Act. In London the company would have first to get the consent of the London County Council and then of the road authority. Any authority could say that as a condition of giving their consent the charge to subscribers should be reduced to, say, £5.

Take the case of Glasgow. Supposing the company wanted to lay underground wires between its exchange and the house of a subscriber, what is the position of the company?—They would first apply to the Postmaster-General for the authority to exercise wayleave powers. Having obtained that they would apply to the Glasgow Corporation for leave to exercise the powers obtained from the Postmaster-General.

With regard to the National Telephone Company is it the practice to do that?—It is. The Glasgow Corporation could make any condition they pleased. This would be by virtue of their right to refuse the original consent, and there would be no appeal. They would not refuse the Postmaster-General in the same way, because he would not apply to them generally, but only for the right of a particular street, and then if they refused he would appeal. If the Corporation or County Council refused a general consent, no company had any right whatever to lay wires between the exchange and a subscriber's house. The London County Council might give this general permission, but as regarded laying the wires between the exchange and the subscriber's house the company would have to get the further authority of the Vestry or District Board subject to appeal. As to the wires between two exchanges of the company, both in the Treasury minute of 1892 or the agreement of 1896, there was a special provision. The Treasury minute said that the Post Office would provide underground wires so that the local authorities might not have to complain of their streets being disturbed. In pursuance of that announcement of policy in the deed of 1896, the Postmaster-General covenanted so far as practicable to connect by underground wires any wires of the company in the same exchange.

The Post Office would not have the power to take up the streets and lay a wire for the company between the exchange and the subscriber's house, how does it get the power to lay a wire between exchange and exchange?—I don't know that there is that power. They contended that the Postmaster-General was the judge whether he wanted a wire, it was not for the local authority to deal with.

Do you contend that the Postmaster-General would have the power to take up the streets between the exchange and a subscriber's house without the permission of the local authority?—No! He would have to go to the local authority in any case, subject to appeal the Post Office would claim the right to lay their wire from the exchange to a subscriber's house, and that would be discussed on appeal. The Post Office had never contemplated such a thing, and therefore the question had not arisen. The Post Office had laid wires for the company between exchange and exchange, and between exchange and Post Office. The Post Office could exercise on behalf of its licensees all the rights and privileges it could exercise for itself, subject only to the right of appeal against the local authority.

By Sir J. Woodhouse: If the Postmaster-General undertook to lay wires for the company and the local authority declined to give its general consent, then the Postmaster could appeal against the refusal. The Post Office in their covenant had undertaken to lay wires between the exchanges for the companies.

So that you are enabling the company to get behind the consent of the local authority?—We were bound to do so under our covenant.

By Sir Henry Howorth: There was nothing in the agreements between the telephone companies and the Post Office to prevent the former from charging differential rates. The Post Office do not enter into their charges except to see that they paid over the 10 per cent. of the receipts. The National Telephone Company claimed to have the right to exclude a private individual from the supply. There was nothing in their arrangements with the Postmaster-General to prevent it. There was nothing to prevent the Postmaster from granting a license to another company to work within the same area.

By Mr. Tully: The Post Office had always made it clear to the National Telephone Company that the Post Office was perfectly free to grant competing licenses at any time. There had never been any substantial competition with the National Telephone Company.

By Mr. Bartley: A corporation with a license from the Postmaster-General, and with authority to exercise his rights of wayleave, could take up its own streets for the purpose of laying telephone wires; but without the license the corporation could not so act. The telephone companies were in possession of lines all over the kingdom, and the Post Office had to acquire them, and if they had made certain conditions the telephone companies would have said, "Well, we will go on as we are."

By the Chairman: In the case of a company determining to work the telephones it would have to get from the Postmaster-General the authority for wayleave powers, then if it were carrying on business within its own area of course there would be no veto on the part of the local authority, because the local authority possessing the veto would be the same. Then as to taking up the streets, in the majority of cases the road authority would be the same body. Therefore, there would be free control of the streets. In the case of a municipality carrying on business outside its own district, in some other borough, for instance, it would be in the same position as the National Telephone Company. It would have to get permission to go into the borough, and if it was granted it would have to go to the road authority to get its consent to take up the roads, and if that were refused it would have to go to the tribunals. In its own area it would to a certain extent adjudicate on its own case. He did not see any legal difficulty in the way of judging their case as suggested.

The Committee adjourned until Thursday.

The Committee of the House of Commons sat for the second time on Thursday, 19th inst., Mr. Hanbury, the chairman, presiding.

The Chairman, at the opening of the proceedings, said the Committee had been considering an application from the National Telephone Company and from the Direct Telephone Company to be heard by counsel, but the Committe were unanimous in the opinion that they could not accede to the application.

Sir Henry Hunter, solicitor to the General Post Office, again attended, with the object of supplementing the evidence given by him at the former sitting. He said that on that occasion Prof. Stuart had raised a question as to whether London came within Section 5 of the Telephone Act of 1892, and had suggested that the words there used were not wide enough to cover London. He (Sir Henry Hunter) read the section in question, and said that in his opinion London came within the meaning of the words "urban sanitary authority." With regard to the suggestion that the Treasury Minute of 1892 contemplated competition between various telephone companies, and that all the enactments in the Telegraphs Act, 1896, were authorised and passed in contemplation of competition, he said that the draft agreements between the Post Office and the National Telephone Company and the New Telephone Company were laid before Parliament. It appeared from the debate that followed, and from the minutes of the Select Committee, that the National Telephone Company had absorbed the New Telephone Company. The Committee reported in July, 1895, and the agreement with the National Telephone Company alone was entered into on March 25th, 1896. On August 19th, 1896, the Act was passed which authorised the raising of an additional £300,000 to carry out the policy of handing over the trunk wires to the Government and leaving the exchanges to the companies. The point was that he thought it was perfectly well known that there was only one company, and that the business would be practically divided between that company and the Post Office, and that Parliament granted additional money with that knowledge.

Sir Hy. Howorth: Was it not granted for the purchase of plant actually in existence at the time?—The preamble to the Act of 1892 stated that it was expedient to raise money with a view of carrying into effect the scheme of the Post Office for requiring the telephones, and particularly with a view of raising money for the trunk lines. The Act of 1896 said the Treasury might issue a sum not exceeding £300,000 for the Postmaster-General's use for the purposes of the Telegraph Acts, and he submitted that that was an express confirmation of the policy outlined in 1892 of buying up the trunk wires in 1896, and that it was known that there was only one company.

By Mr. Griffith-Boscawen: The £300,000 was solely for the purchase of the trunk wires.

By the Chairman: His evidence went to show that Parliament was duly seised of knowledge that the two companies had become one at the time. It was moved in the House of Commons that the agreement should not be confirmed, and the mover based his case upon the fact that the National Telephone Company had absorbed the New Telephone Company, and that there was practically only one company, and the Government was carrying out a bad policy when there was only one company. The arrangement was solely in reference to trunk lines. Parliament was aware at the time that there was no competition, apart from the Post Office, with the one company, and it might have challenged the policy of the Government when this money was granted.

By Mr. Tully: The agreement was not executed until 1896. He did not think there was any understanding on the part of the Government and the Post Office that the execution of the agreement should be suspended.

By the Chairman: With regard to the trunk wires, he had said on the last occasion that he thought that if the National Telephone Company gave preference to the messages of its subscribers, that would be a breach of the agreement. He had since referred more closely to the agreement of 1896, and had found that there was a distinct covenant on the part of the company that they would do everything to enable messages to be carried over trunk wires, not only between their own subscribers but between subscribers to other exchanges also.

By Mr. BARTLEY: To postpone the sending of other messages in favour of those of their own subscribers would be a breach of the agreement, as that was over the trunk wires.

By the CHAIRMAN: In 1884, when the form of the new license was being debated, it was considered whether the Government should insert in that license a clause preventing the Telephone Company from giving favour or preference to one over another. It was eventually decided not to insert such a clause. The reason was obvious. At the time of the draft public opinion was in the direction of giving the telephone companies a free hand. Up to that time the Post Office had imposed a great number of restrictions, and it was proposed to remove all these restrictions, and give the telephone companies a free hand.

By Mr. COHEN: His opinion was that if the Telephone Company gave preferential treatment to their own subscribers they would not be carrying out their contract. They would be deliberately delaying a message, and would not be doing all the necessary acts and things to carry out the agreement.

Prof. STUART: Would a breach of that clause by the company entitle you to revoke the license?—I think not, but we could bring an action against them.

Do you think it completely safeguards the public in that respect?—I think so.

Do you mean to say you think the Telephone Company would object to words being put in to prevent them by any possibility giving preference to their own subscribers?—I really cannot say. All these questions were minutely considered at the time. He would not say that these particular words were considered, but the whole of the arrangements between the Post Office and the company were most elaborately debated. He thought the clause he had referred to was sufficient to safeguard the interests of the public.

By the CHAIRMAN: Preference in time would constitute a branch of the agreement, but he could not say that a preference in rates and charges would do so.

I do not see where the difference comes in.—They must not do anything that delays one message for another.

Surely the principle of preference applies to rates and charges as well?—That was not dealt with.

I want to get it clearly that the preference in time of one person over another would constitute a breach of the agreement, but the preference in charges would not.—I do not think it would.

By Mr. FRY: The breaches which would entitle the Post Office to determine a license would be the non-payment of the royalty and the sending of messages out as telegrams, writing them down as telegrams.

By Prof. STUART: No doubt these were points to secure the specific interest of the Post Office, not points to protect the public. There was no intention in the agreement to fix the rates the company should charge. He would not say the question of preference was considered from this point of view when the agreement was drawn, but it was considered. He did not think that the company would have submitted to any restriction on the way in which they were carrying on their business as between themselves and their subscribers. The view in 1884 was that the telephone could be best dealt with by throwing it open to free action.

How is it the Post Office can give its licensee the power of charging preferential rates which, by law, it does not possess itself?—The Post Office did not give its licensees the right of making preferential rates. All that the Post Office did by its license of 1884 was to remove the restrictions which would otherwise make every telegram which was transmitted illegal. But for that, all these telephonic messages would be illegal. It was thought in 1824 that the best thing to do was to leave the companies open to make any terms they liked. There was nothing to prevent the company giving a preferential rate to a man doing a large business over one doing a small business. Whey they got their exchange license it was thought better to give them a free hand. From 1892 to 1896 it was a matter for negotiation. The Government could not make the companies accept any terms they thought fit.

By Mr. BARTLEY: He would rather not give any opinion as to whether it was fair that the same restrictions should be imposed upon the companies as were imposed upon the Post Office. As to whether it was right that they should have privileges which were not possessed by the Post Office, it seemed to him a question of policy.

By the CHAIRMAN: The question of policy was fully considered in 1884. He would prefer that Mr. Lamb should answer the question as to whether it was considered in 1892.

Mr. F. T. LAMB, second secretary of the Post Office, examined by the CHAIRMAN, said his special department was the telegraph and telephone service. He was in charge of the telegraph department, which position he had occupied since April, 1889, and for many years before he had had a great deal to do with it. He had been concerned in the administration of the telegraphs since 1870. He gave evidence before the Committee of 1892, and also before that of 1895. The principal recommendation of the Committee of 1892 was that the license of the Telephone Company should not be extended beyond 1911. It left the Government the responsibility of entering into arrangements with the telephone companies, and made that recommendation that the license should not extend beyond 1911. He had a hand in drawing up the Treasury Minute, in the sense that he prepared the information for the Post Office, which was embodied in that minute nearly word for word. That information was prepared in view, at any rate, of limited competition. All along the Post Office and the Treasury had in view competition, and freedom of competition was reserved carefully from the earliest date, and it was again reserved in that minute. In 1892 agreements were drawn up. They were not signed, but they were initialled by the Postmaster-General and the representatives of the two companies. That was in August, 1892. The Postmaster-General, Sir James Fergusson, initialled them on behalf of the Government. The Duke of Marlborough initialled one document on behalf of the New Telephone Company, and Mr. Forbes the other document on behalf of the National Telephone Company on August 11th, 1892. The heads of the agreement so signed were embodied in the agreement of March 25th, 1896. The final agreement was with one company.

Did the Post Office encourage the amalgamation of these two companies?—It was not a question of the Post Office. It was a question of the Government, who gave direct instructions to the Postmaster-General. The Postmaster-General was in constant communication with the Chancellor of the Exchequer, and acting for the Government, he facilitated the amalgamation of these companies. Practically, the amalgamation had taken place when the heads of the agreement were signed.

In 1889 Mr. Raikes was Postmaster-General, and offered strong opposition to the amalgamation. Was the same opposition offered by the Postmaster-General to the amalgamation in 1892?—No, certainly not. Not only was there no opposition to amalgamation, but it was rather encouraged; but that was not the Post Office, but the Postmaster-General acting on behalf of the Government. The agreement undoubtedly facilitated the amalgamation of the National Telephone Company with the New Telephone Company, and was signed with the full knowledge of the Chancellor of the Exchequer and, he believed, other members of the Government. The formal signatures were attached on August 11th, 1892, in Sir Jas. Fergusson's room in the House of Commons. He would not say that the Ministry had authorised an agreement which was contrary to the Treasury Minute issued in March, 1892. He was in constant attendance at the House of Commons with the Postmaster-General, and was present at discussions, and he knew that the Postmaster-General acquainted the Chancellor of the Exchequer of what was going on.

The examination of the witness had not concluded when the Committee rose.

CORRESPONDENCE.

Limerick Electric Tramway Scheme.

As a subscriber to your esteemed periodical, which I regularly receive through your Berlin agency, I take the liberty to put the following before you.

In your number (No. 1,067, May 6th, 1898, page 622) I find this notice:—

"*Limerick.*—The firm of Zietz, of Hamburg, are stated to have written to the Corporation in quaint English, offering to establish an electric tram system all over the city, 'without any cost, on getting a lease of the streets.' This is cool! We guess many an English promoter would like to get tramway concessions on these terms."

There is no doubt that my firm is alluded to, and as I cannot allow to be ridiculed in anybody's eyes, I beg to hand copy of two letters, which are the only ones I addressed to the Corporation of Limerick, and from which you will learn that there is nothing like any "cool offers," but only a commercial offer of my services.

As to the Liverpool order you refer to just under the Limerick notice, I beg to state that same was given to me, respectively to my friends the Wagenbauanstalt und Waggonfabrik für Elektrische Bahnen (vormabs W. C. F. Busch) of our place.

As it cannot be in the interest of your REVIEW to give any wrong information, or to allow anybody to ridicule any of your subscribers or to harm their interests or position, I should thank you to make use of my to-day's information in such way as you may think fit.

Ed. Zietz.

[COPY].

To the Town Clerk
Of the City of
Limerick (Ireland).

Sir,—I take the liberty to inform you that I have provided the Liverpool Tramways Corporation with some samples of *Cars for electric traffic*, completely fitted out.

The respective Committee will visit this city at the beginning of March to look over our electric car traffic, which is the best and largest on the Continent, as we are running about 700 cars with overhead system.

Supposing that ere long your Corporation also intend to transform your horse tramcars into electrical cars, I beg to offer you my services for anything you may require to this purpose. Any details will be given with pleasure on application.

Hoping to be favoured with your reply.

I am, Sir,
Yours respectfully,
(Signed) ED. ZIETZ.

[COPY].

Hamburg, *April 22nd*, 1898.

To the Town Clerk
Of the City of
Limerick (Ireland).

Sir,—Referring to my respects of February 19th, I beg to inform you that since then the Liverpool Committee have inspected our electric tramcars traffic, and that at the meeting held at Liverpool a resolution has been taken to order from me for their trial line 14 *motor cars and* 14 *trailer cars fully equipped*. This order gives you a full proof that I am in the position to provide you with the necessary, and I am looking forward to your good news.

Yours respectfully,
(Signed) ED. ZIETZ.

[Our brief comments were made on the information—now shown to be very meagre—received from a local source. The correspondence printed contains no mention of terms proposed by Messrs. Zietz, therefore the reference to cost and lease seems to be a mere fabrication of the Irish mind. We offer our apologies to our correspondent.—EDS. ELEC. REV.]

Testing of Magnet Steel in Bulk.

With reference to the point raised by Mr. Mordey in the discussion on Prof. Ewing's paper on the importance of knowing the magnetic qualities of soft magnet steel in bulk. It would appear that the variations in magnetic quality has much improved of late owing to the steel makers having come to the conclusion that it pays them to make special blows of steel instead of using any mixture they may have in hand at the time.

The South Staffordshire Steel and Ingot Company, for example, who turn out very large quantities of soft magnet steel appear to have found out exactly what is wanted, and by taking a little trouble with the mixture and with the chemical analyses, the quality is practically constant for each "magnet steel blow," which they now make at frequent intervals. At the same time it would undoubtedly be a great advantage for electrical firms to be able to make their own tests of the magnetic quality of castings and ingots *in bulk*, and in the absence of any such method, the writer thinks that perhaps the following suggestion may be interesting:—

An electro-magnet similar to those which are now taking the place of crane hooks, but with tapered and rounded poles, is suspended over an ordinary weigh table. When the ingot or casting comes forward to be "weighed in" by the the stores department, two places are fettled up at, say, a foot apart, for the electro-magnet poles to rest against. After the casting has been weighed in the usual way, the magnet is brought against it and a known current is switched on. The weights are then run off the scale beam in the weigh office until the casting drops away from the electro-magnet.

It seems to the writer that this is roughly analogous to the traction method of testing as used in Prof. Ewing's instrument, and that the difference between the actual weight and the weight at which contact is broken is a measure of the magnetic quality of the steel lying adjacent to the pole-pieces of the electro-magnet.

E. Kilburn Scott.

The South Staffordshire Steel and Ingot Company, Limited, turn out over 50 tons of soft magnet steel per week in ingots, &c., weighing up to 7 tons each. The following is the average chemical analysis:—

Carbon	·075 %
Manganese	·380 %
Sulphur	·075 %
Phosphorus	·060 %
Silicon	trace.

"Honour to whom Honour is Due."

An article in your issue of last week, entitled "Honour to whom Honour is due," seems scarcely fair to James Wimshurst. Since 1775, when Volta invented the electrophorus, induction machines have, by common consent, been named after those who have introduced improvements in the mechanical and electrical details of the development of the cardinal idea. Thus, Toepler and Carré, Kelvin and Varley, are all credited with having invented induction machines; and induction machines have been named after them. In all these cases the right and honour of invention goes to the man who fashions a machine qualified, by its details, for specific purposes, or for convenience in its mode of operation.

Experiment has determined that the machine made by Wimshurst possesses the following *simultaneous* characteristics: (1) It is self-exciting. (2) Its polarity is subject to no capricious reversals. (3) It does its work well in all weathers. (4) Its discharges can be regulated as to quantity, potential, and rate of interruption. (5) It is, for some purposes, the best possible exciter for Röntgen-ray tubes (see *Proc. Röntgen Soc.*) and allied phenomena. It is upon these *simultaneous* characteristics that the right and honour of invention is ascribed to him.

The skeleton figure, accompanying your article, no doubt represents the best that could be attained before 1883. But, unfortunately for your argument, that machine would not possess the *simultaneous* characteristics (1) (2) (3) (4) and (5). We can afford to give Prof. Holtz much credit for his work, but the merit of having invented the "Wimshurst" machine should no less be given to our own esteemed countryman, James Wimshurst.

Rollo Appleyard.

May 23rd, 1898.

Alternating Arc Lamp.

I have been experimenting with an alternating arc lamp, and find my greatest trouble is that the current has a tendency to run up the side of the carbon. Could you or any of your readers inform me any means of keeping this down, and the cause? Is it the quality of the carbon, or the E.M.F. in the too (?) high which is 72 volts at 7 amperes, 13 mm. cored carbons are used? This lamp burns fairly steady till it flares, when the light changes from a white to a violet colour for the instant. The lamp burns at 100 volts on its terminals, no impedance coil is necessary, and I am therefore anxious to get it to burn steady. I shall be much obliged if I can obtain any information.

W. Addley.

[Our correspondent has apparently left out the word "arc."—EDS. ELEC. REV.]

THE "HART" SECONDARY BATTERY.

WE announced a few weeks since that Mr. E. J. Clark had left the Electrical Power Storage Company to take the management of the business of the "Hart" Secondary Battery Syndicate, Limited. At that time the Syndicate had just taken possession of premises at Crispin's Wharf, Stratford, London, which, though admirably adapted for its purpose, required a considerable amount of fitting up. That the Syndicate is now in a position to execute orders indicates the possession of energy which deserves success.

At present arrangements have been made to manufacture three types of battery, namely, for traction, lighting, and central station purposes. The traction cell consists of 11 plates, weighing 38 lbs., with a capacity of 150 ampere-hours at a discharge of 50 amperes, equal to ·4 H.P. for one hour. The lighting type has a capacity of 40 ampere-hours per positive at a discharge rate of 15·6 amperes; at half rate a capacity of 55 ampere-hours. The central station cell is constructed to meet the demand of consulting and central station engineers for a battery that will stand a very heavy discharge for a short period. The plate is calculated to sustain a discharge at 100 amperes for one hour, as a maximum, and at the same time leave a safe working margin.

With all kinds of cells a novelty is supplied in the shape of a non-corrosive connection decreasing the resistance and saving much trouble in cleaning.

The principal improvement claimed in connection with the construction of the plates is that by some process not explained, the active material is hardened and does not suffer disintegration under heavy strains.

The plates for the traction cells are also provided with an additional protection to the active material, little lugs being arranged so as to fold over and hold the contents of the plates in rigid position.

By decreasing the weight of the grids and increasing the proportion of active material as compared with the inactive,

it is claimed that for a given weight of cells at least 40 per cent. is gained in capacity.

With respect to the Syndicate it is composed of some of the leading public men in West Ham and the neighbourhood, and is putting down plant for an output of 6,000 or 7,000 plates per week. The works are very favourably situated just off the main Stratford Road, with a canal by which heavy material can be brought to the gates. Every department is well lighted, and all the operations can be carried on under healthy and wholesome conditions.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending May 24th, 1897.	£	s.
Alexandria. Teleph. mat.	75	0
Amsterdam	150	0
Bombay	7	0
Brisbane. Tele. cable ...	1,217	0
„ Teleph. (joint boxes)	420	0
Buenos Ayres	25	0
Calcutta...	19	0
Cape Town	580	0
Christiana	17	0
Copenhagen	21	0
Durban	729	0
East London	46	0
Hamburg	150	0
Madeira	526	0
Melbourne	229	0
Piræus. Teleg. mat. ...	40	0
Port Elizabeth	80	0
Shanghai	26	0
„ Teleph. mat.	47	0
Singapore	180	0
„ Teleph. mat.	31	0
Sydney	70	0
Wellington	888	0
„ Teleg. mat.	248	0
Total ...	£5,749	0

Week Ending May 24th, 1898.	£	s.
Amsterdam	83	0
Antwerp	138	0
„ Elec. fuses	283	0
Beira	256	0
Bombay	45	0
Boulogne	39	0
Calcutta...	379	0
Cape Town	623	0
Copenhagen	12	0
Delagoa Bay	57	0
Durban	51	0
East London	149	0
Flushing	15	0
Fremantle	215	0
Gibraltar	75	0
Gothenburg	47	0
Halifax	820	0
Hamburg	195	0
Hong Kong	58	0
Madras	208	0
Melbourne	32	0
Natal	1,360	0
North Atlantic. Teleg. cable	10,800	0
Port Elizabeth	1,403	0
Rotterdam	42	0
St. Petersburg. Elec. launch	420	0
Singapore	170	0
Stockholm	232	0
Sydney	610	0
Trieste	240	0
Wellington	49	0
Yokohama	160	0
Total ...	£19,266	0

Foreign Goods Transhipped.

	£	s.
Durban	19	0

Alleged Fraud.—At the Manchester City Police Court this week Thomas Scott was charged with obtaining sums of money from Manchester tradesmen by false pretences, among them being Mr. Geo. Margetts, manager for the district of Drake & Gorham. Prisoner was remanded.

Cable Making in Germany.—A company has just been formed in Berlin, with a capital of £300,000, to be known as the See-Kabel Gesellschaft, to manufacture electric cables, and to acquire and carry on the works and business of Herr Franz Clouth at Nippes.

Cowper-Coles Parabolic Reflector.—A sole license has been granted to MM. Sautter, Harle & Cie, of Paris, for manufacturing parabolic reflectors by this process for searchlights in France, Russia, and Spain.

Dissolutions of Partnerships.—Messrs. F. Reid, F. S. Reid & W. H. Ferens, carrying on business as electrical engineers and agents, at Newcastle-on-Tyne, under the style of F. Reid, Ferens and Co., have dissolved partnership by mutual consent. Debts will be attended to by Messrs. F. Reid & W. H. Ferens, who will carry on the business under the old style.

Messrs. B. Wild, J. H. Clarke, and W. Rothwell, carrying on business as general electrical engineers at 6, Virginia Street, Southport, as Wild, Rothwell & Co., have dissolved partnership by mutual consent. Debts will be attended to by Messrs. Wild and Clarke.

Drake & Gorham Electric Power and Traction (Pioneer) Syndicate, Limited.—In order to deal with the motive power transmission schemes and light railways and tramways which are brought to Messrs. Drake & Gorham in the course of their business, they have formed a powerful syndicate to deal with the preliminaries, and arrangements are being made for a company with a capital of about £250,000. Mr. J. F. Albright, late managing director of Crompton & Co., has joined the syndicate as joint managing director with Mr. Drake, and the syndicate is already in negotiation for acquiring several important schemes for electric traction, power transmission, &c. To avoid misunderstanding, we are asked to state that, while the name of the syndicate is the Drake & Gorham Electric Power and Traction (Pioneer) Syndicate, the business and organisation are quite separate from Messrs. Drake & Gorham's own business, and the syndicate will deal direct with any persons, firms, or local authorities who may wish to negotiate for the promotion or financing of electric traction or power schemes. Offices have been taken at 66, Victoria Street, Westminster, to which all inquiries should be addressed.

Devon County Agricultural Show.—At the above show, which was opened last week at Newton Abbott, Messrs. Lord and Shand, electrical engineers, of Plymouth, shewed a number of electric motors driving a variety of agricultural and domestic machines, such as cream separator, chaff cutter, coke crusher, and horse clipper. The necessary current was obtained from a Taunton dynamo, driven by a Hornsby-Ackroyd oil engine exhibited by Messrs. Beare & Sons, agents at Newton Abbott. The current was supplied to two 1½-H.P. Taunton motors, manufactured by the Newton Electrical Works, Limited, and 10 Lundell motors of various sizes by Messrs. Veritys, Limited.

Electric Clock Switches.—We understand that Messrs. James & Browne have just despatched a dozen of their patent automatic electric clock switches for use in the arc lamp standards at Exeter. A description of these switches, which are for automatically putting current on and off at any desired time, appeared in our issue of February 18th last.

Electric Power in Shipyards.—An installation of electrical transmission of power has recently been carried out by Messrs. W. H. Allen, Son & Co., of Bedford, at the well-known shipbuilding yard of Messrs. Harland & Wolff, Limited, of Belfast, comprising a direct current 500-volt belt-driven generator, and five motors, varying in size from 12 B.H.P., all of Messrs. Allen's manufacture. The generator is compound wound, and the motors shunt wound, whilst the cables run for a distance of 100 yards on steel tubular poles. Messrs. Allen have now secured an additional order from the same firm. This new installation will be one of the largest of its kind in the United Kingdom when completed, and will consist of a 550 I.H.P. compound three-crank forced lubrication engine, running at 300 revolutions per minute, direct coupled to a three-phase 350 kilowatt generator. There will also be seven three-phase motors, four of 100-H.P., one of 75-H.P., one of 50-H.P., and one of 20-H.P., distributed throughout the shipyard for driving the various departments.

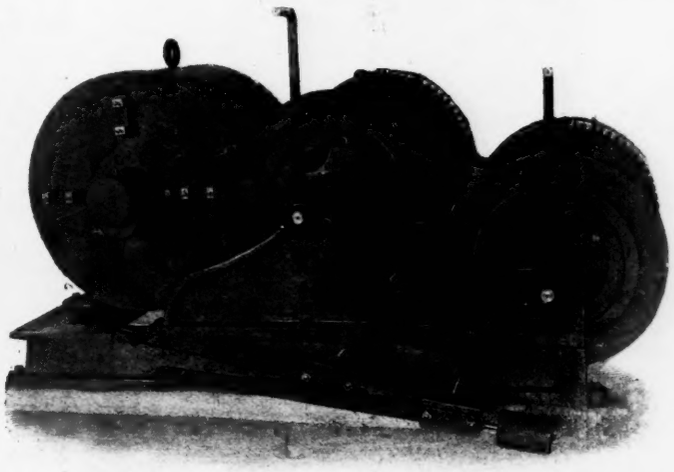
The Electrophone.—The Princess of Wales and Princess Victoria upon two evenings last week listened to the leading London theatres through the electrophone which is installed in the private boudoir of the Princess of Wales at Marlborough House.

Hammond v. The Electricity Supply Company for Spain, Limited.—This was a motion on the part of Mr. Robert Hammond, the plaintiff, heard before Mr. Justice North in the Chancery Division, on Tuesday, to restrain registration of a transfer of shares in the defendant company, of which he claimed to be beneficial owner. The defendants, other than the company, were Don Pedro Pastor y Landero, the transferor, and Mr. R. C. Wyatt, the transferee. Owing to the fact that the Spanish Government would not permit service of a concurrent writ on Don Pedro Pastor y Landero, who is in Spain, it appeared the plaintiff had not been able to bring him before the Court, and the motion therefore stood over. Mr. Kirby was for the plaintiff; Mr. Martelli for the defendant, Wyatt; and Mr. K. H. Leach for the company.

London County Council and the Smoke Nuisance.—At the weekly meeting on Tuesday, the Public Control Committee brought up a report in reference to the smoky atmosphere of the metropolis during the past few weeks. In this connection the committee mentioned that they had addressed to 23 Vestries and District Boards a letter stating that many complaints have been made during the past few weeks of the "very serious nuisance caused by the emission of black smoke in large volume from chimney shafts in various parts of London. The nuisance has probably been most serious in the central districts, and has largely proceeded from electric light generating stations and hotels. The cause is almost invariably attributed to the difficulty now experienced in obtaining smokeless coal, and to the consequent necessity of using bituminous coal in the furnaces of steam engines. If this difficulty had proved to be of a very temporary nature, it might not have been desirable during its continuance to strictly enforce the law as to smoke consumption, but it has already lasted upwards of six weeks, and there appears to be no indication of its speedy cessation. Meanwhile the most serious inconvenience continues to be caused, apparently without any attempt being made to mitigate the evil, notwithstanding that by proper precautions and careful stoking, much of the nuisance might be prevented. In some districts legal proceedings have already been instituted, and the Council believes it to be necessary in the public interest that steps should now be taken for strictly enforcing the law in every serious case which may occur." Sir Harry Poland moved that the report should be referred back, in order that the committee might bring up a recommendation with a view to stopping the nuisance. Mr. Lawson, who seconded, suggested that the Council should initiate legislation next year in order to deal with the question. Mr. H. Ward attributed the large volumes of dense smoke to the fact of the steam at the electric light stations not being condensed. The result was that the steam was discharged into the stacks, and assisted in driving the carbon particles into the atmosphere. On a show of hands, the report was referred back to the

Committee by 23 votes to 21. The Council approved on the recommendation of the Building Act Committee the plans submitted for the extension of the Carnaby Street station of the St. James's and Pall Mall Electric Lighting Company. Formal consent was given to the laying of new mains by the Metropolitan, the House-to-House, and the County of London Electric Lighting Companies.

C. & C. Electric Hoist.—The hoist shown in the illustration was supplied to Messrs. Belshaw & Co., of Victoria Street, by the C. & C. Electric Company, of New York, through their representative for the United Kingdom, Mr. C. R. Heap, 47, Victoria Street, London, S.W. The motor, which is stated to possess several novel features, is of the "C. & C." direct current (compound wound and over compounded) ironclad totally enclosed four-pole slow-speed type. It develops 40 H.P. on the brake, with 450 volts at the terminals, running at a speed of about 750 revolutions per minute. The hoist is of the double drum type. Either drum may be worked independently in either direction, there being a separate friction clutch, brake, and reversing gear for each. Thus raising or lowering may be accomplished as required by either drum. The duty of the machine is to raise 1 ton plus the weight of 500 feet of steel wire rope up an incline of 60° at a speed of 300 feet per minute. The motor will run at practically a constant speed, the power and speed of hoisting being varied, as well as the direction of travel of drums by the brakes, clutches, and gear. Thus the working is said to be simple and reliable. There are no complicated controlling and reversing resistances, and the hoist can be managed with safety by an unskilled operator. For starting the motor the "C. & C." standard starting box is used. It comprises, besides a double-pole switch and safety fuse, a graduated shunt resistance with 10 steps, and an automatic "overload" and "no load" release. Through this apparatus, if the current to the motor is interrupted, the starting handle will return quickly and automatically to the "off" position, and the motor can only be restarted in a proper manner through the "step-by-step" resistances, thus preventing any danger of injury to the motor by starting again with load on and motor at rest. The same action occurs with an overload, and thus a finely graduated fuse is unnecessary. The whole machine is compact, and massive in build, and is mounted on one solid bedplate. The weight of the whole is about 8,000 lbs. Owing to its entirely enclosed form, the motor is damp- and dust-proof. It is provided with self-feeding carbon brushes, requiring no change of lead under any variation of load, and needing the minimum of attention. The bearings are oiled by "ring lubrication," the oil reservoirs carrying an ample supply of oil, and are fitted with visible oil gauges and drain cocks all accessible from outside. By the removal of close-fitting hand-hole covers at both ends the armature is readily accessible. These hoists are made in standard sizes, from 5 to 50 brake horse-power, and are made on the "interchangeable" plan throughout.



Lists.—The Simplex Steel Conduit Company, Limited, of Coventry Street, Birmingham, have issued lists of their "ideal" system of wiring for electric light, power, bells, and telephones. The lists detail the various advantages claimed for the system, and give particulars of some installations carried out. The company has equipped works capable of a large output of steel conduit, together with all accessories in the way of T's, bends, and inspection pieces.

New Electrical Works.—It is stated that the old cotton mill on the Buxton Road, Bakewell, and land adjacent, have been purchased by Messrs. Drake & Gorham, electrical engineers. The necessary alterations are to be made to adapt the buildings to Messrs. Drake & Gorham's business. As a cotton mill the place gave employment to about 100 hands. There is ample water-power obtainable from the River Wye. The site is (or was up to the time of the purchase) the property of the Duke of Devonshire.

Patent Litigation.—The Comptroller gave his decision on 17th inst. in the matter of the Electrolytic Plating Apparatus Company's (Walsall) opposition to the grant of letters patent upon G. H. Nash's (W. Canning & Co., Limited, Birmingham) patent application No. 14,708 of 1897, for "An improved apparatus for the electro-plating of small articles." Messrs. W. P. Thompson & Co., of Birmingham, appeared for the opponents at the hearing, and Mr. A. J. Walter (instructed by Redfern & Co., London) appeared for the applicant. The grant of letters patent was opposed on the grounds that the applicant (Nash) had obtained the invention from the Electrolytic Plating Apparatus Company, Limited, and that the invention had been patented in this country on an application of prior date, viz, by British patent No. 5,274, of 1896, vested in the Electrolytic Company. The Comptroller by his decision ordered Nash to insert a disclaiming clause in his complete specification, and also to strike out a certain portion of the existing letterpress thereof; subject to this being done he would seal him a patent.

Personal.—Mr. John Hunter, late electrician to the Allan Line Shipping Company, Liverpool, has been appointed manager of the Liverpool Electric Lighting and Fittings Corporation, Limited.

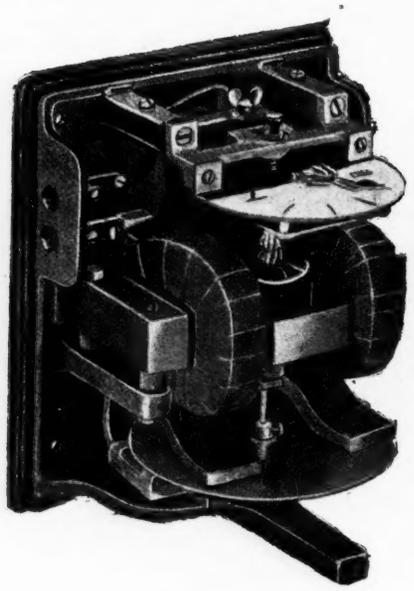
Private Installations.—Messrs. Archer, New & Co., of Liverpool, have carried out a number of installations connected with the Liverpool, Birkenhead, and Southport Corporation mains, under the supervision of Mr. F. W. Rayner, late Liverpool manager of Messrs. New & Mayne. They have also put down a complete installation for the cotton warehouse of the Liverpool Warehousing Company, Limited, a 30-ampere Parker dynamo being run from a hoisting engine. The buildings are wired on the wrought-iron conduit system. A 30-ampere dynamo and Crossley oil engine has also been installed at Aigburth for Mr. Hollbrook Gaskell. They have fitted up Leasowe Castle Hotel and Hydro, Cheshire, for 500 lights, and six enclosed arc lamps in the grounds. An Edison and Swan dynamo, 200 amperes, and engine room switchboards, 60 E.P.S. K 21 accumulators, British Insulated Wire Company's underground paper insulation mains, and a Robey horizontal engine and Lancashire boiler, make up the installation. The Prince of Wales Hotel, Southport, has been fitted with 390 lights to be supplied from the Corporation mains; also 130 electric bell communications. Messrs. New's business is to be absorbed shortly by Messrs. New & Byrd, Limited.

Submarine Miners and the Electric Light.—The *Western Mail* says that a party consisting of two officers and 10 men of the Severn Division Royal Engineers (Volunteer Submarine Miners), whose headquarters are at Cardiff, are at present undergoing a month's course of instruction at Plymouth in electric lighting. The course consists of a series of lectures on the theory of magnetism and electricity, and the construction of the various kinds of dynamos and lamps used in the service for electric lighting. The practical work consists of instruction in the running of steam and oil engines, the working of dynamos, and the manipulation of "fixed beam" and "search" lights. The practical work takes place by day and night in connection with the forts, &c, at the entrance to Plymouth Sound.

Veritys, Limited, v. Sharp.—On Friday, in the Queen's Bench Division, before Mr. Justice Day, sitting for the trial of non-jury causes, the case of Veritys, Limited, *v.* Sharp came on for hearing. This was an action brought by Messrs. Veritys, Limited, who are electric lighting engineers, of King Street, against the defendant, who is an electric lighting engineer, to recover £90 8s. 8d. in respect of electric light fittings sold and delivered to the defendant for an installation at 56, Ludgate Hill. Mr. W. W. Thompson was counsel for the plaintiff, but the defendant did not appear, nor was he professionally represented.—Mr. Lionel George Conter, traveller for the plaintiff company, deposed to receiving the order from the defendant, in response to which the goods were delivered to him at Ludgate Hill. Mr. Sharp acknowledged the receipt of the goods. The plaintiffs had frequently applied for payment of the account, but it had not been paid.—His Lordship gave judgment for the amount claimed, with costs.

Wattmeters for Storage Batteries.—The increasing application of storage batteries to electric light and railway station use, as well as to street cars, motor carriages, electric launches, &c., where a portable source of power is requisite, has led the General Electric Company, of Schenectady, to develop a special type of meter, which will show at a glance the amount of energy available in the battery. The Thomson recording storage battery meter, as described in the *Street Railway Journal*, resembles in general appearance the standard Thomson recording wattmeter, and is, in fact, a development from it, the mechanism being almost exactly similar. The accuracy and durability characteristic of the standard type have both been maintained, while additional precaution is provided against injury from shock or vibration. The meter is provided with a single indicating needle moving over a horizontal semi-circular dial. The essential requirement for a storage battery meter is that the armature shall rotate in either direction and give equally accurate

readings in both. In this meter this requisite is obtained. The reading of the meter represents not the amount of energy put into the battery, but the amount available, and when the needle points to zero on the dial, it shows that the battery is completely discharged. For motor carriage, street car, and electric launch service a meter of this character is a most necessary adjunct. Without it the operator is absolutely ignorant of the power upon which he can depend, and would run serious risk of finding himself at a standstill far from home with no means of getting either forward or backward



without recourse to some mechanical method. These meters are manufactured with any desired percentage difference between charging and discharging rates, and in all of the standard sizes in which two-wire Thomson recording wattmeters are built. Since, however, this percentage varies in almost every case, the General Electric Company manufactures them only to order. One size, that reading to 50 amperes, however, may be considered as standard, and will be more promptly furnished than any other.

Wireless Telegraphy.—Some experiments were made from the Terrace of the House of Commons on the morning of the 20th inst. The apparatus was fixed in a private smoke room just off the Terrace and in the treasurer's office of St. Thomas's Hospital, on the other side of the Thames.

ELECTRIC LIGHTING NOTES.

Barmouth.—Mr. T. Blackburn, C.E., and Mr. David Davies have each prepared a dust destructor and electric lighting scheme for the town. The District Council has appointed the Lighting Committee to consider both proposals and report.

Belfast.—Last week the electrical engineer was instructed to communicate with the contractors for new engines, requesting them to have the engines forwarded at once, the tests already made being of a satisfactory nature.

Blackpool.—Mr. Quin, the Blackpool borough electrical engineer, has just issued his report for the year ending March 31st last. The total revenue was £12,827, which included public and private lighting. The expenditure on working account was £7,152, and £3,856 was set aside for interest and sinking fund, being at the rate of 5¾ per cent. for these items. This leaves the sum of £1,819 as the net actual profit on the year's working. As the profit last year was only £828, there is a substantial increase. The units sold have gone up from 429,669 to 707,965, but the "generation costs" have gone down from 2·61d. per unit to 1·87d., a highly creditable result. The "general costs," too, have gone down from 64d. per unit to ·39d. The "total costs" of working per unit have gone down from 3·41d. to 2·42d. Mr. Quin deserves every credit for these reductions in costs of working. The total revenue has gone down from 5·5d. to 5·13d. per unit.

Cardiff.—The Electric Lighting Committee last week instructed the engineer to report on the question of the electric lighting of Newport Road.

Chelmsford.—The Board of Trade have confirmed the provisional order promoted by the Chelmsford Electric Lighting Company for the extension of their mains into the districts surrounding the borough, and have specified Springfield as a compulsory area.

Chester.—The Council last week authorised the Lighting Committee to have an electric main for street and private lighting, and for supplying motive power to compress air for the ejectors at the Infectious Diseases Hospital, Sealand, laid at an estimated cost of £1,100, of which £460 is to be charged to cost of the Infectious Diseases Hospital; to carry the new main to be laid along Brook Street, past the station, and connect it with the main in City Road, at the estimated cost of £55; to have a small addition made to the switchboard at the electric light station, at the estimated cost of £36, and to accept the tender of Messrs. Johnson & Phillips to supply 11 arc lamps for the Lower Bridge Street and Castle Esplanade extensions, for £136 11s.

Chiswick.—The District Council had a discussion last week regarding the "alleged scandal" in respect to the electric lighting order, and ultimately a Committee was appointed to interview Messrs. Bourne & Grant on the matter.

Conway.—At a meeting of the Conway and Colwyn Bay Water Board last Friday, a member expressed the opinion that the Board had valuable water rights which could be utilised for electric lighting purposes, and he moved that a committee visit the place and inquire into the matter. It was also proposed that a professional man be engaged to advise the Board. The Mayor was of opinion that the Board should carry a scheme through, or a company would soon be formed for the purpose. Mr. T. T. Marks, C.E., was appointed to advise the committee.

Coventry.—The statement of the Electric Light Committee shows the progress of the undertaking as follows:—Electricity supplied during quarter ending December 31st, 1897, 34,895 units; 1893, 25,685 units. Rentals for quarter, 1897, £830 8s. 9d.; 1890, £618 5s. 6d. Number of consumers on December 31st, 1897, 100; 1896, 72. Mileage of mains on December 31st, 1897—high tension, 2 miles 687 yards; low tension, 2 miles 1,331 yards; 1893, high tension, 2 miles 77 yards; low tension, 2 miles 332 yards. Electricity supplied during quarter ending March 31st, 1898, 35,090 units; 1897, 21,516 units. Rentals for quarter, 1898, £891 4s. 5d.; 1897, £547 6s. 5d. Number of consumers on March 31st, 1898, 112; 1897, 76. Mileage of mains on March 31st, 1898—high tension, 2 miles 1,592 yards; low tension, 3 miles 791 yards; 1897, high tension, 2 miles 337 yards; low tension, 2 miles 432 yards.

Darfield.—The Council will oppose the scheme of the Electric Lighting Syndicate so far as it may concern the Darfield district.

Dewsbury.—The Corporation are extending their system of street electric lighting, and already eight additional lamps have been erected. The improvement which has thus been effected has met with general approbation, and already many desires have been expressed in favour of a further extension. Householders and shopkeepers are asking for the extension of the mains to the outlying portions of the borough.

Doncaster.—The District Council will oppose the General Power Distributing Company's scheme for electric lighting in the district.

Dunoon.—The Police Commission has resolved, on the recommendation of the Pier and Parks Committee, to use the balance of current from the Castle dynamo for lighting the pier electrically. The offer of Messrs. Dixon to erect wires and lamps at £15 odd has been accepted.

East Stonehouse.—The Bill confirming the East Stonehouse provisional order was certified for second reading last week.

Greenock.—At a recent Police Board meeting the minutes contained a report of the conference with the Board of Trade on the subject of supplying electricity in the burgh. The Provost said it was absolutely necessary, if they should retain their provisional order, that steps be taken towards the installation of electricity within a year. They were clearly led to understand that the opposing company would in a year hence be in a much more favourable position if the Council showed they were not in earnest in the resolution passed to proceed with the installation. They felt very much indebted to the authorities of Port Glasgow and Gourock for the assistance which they gave them, and they made it clear to the Board of Trade that they would prefer to have the electricity supplied by Greenock rather than by a private company. Mr. John Cameron said the Board of Trade were surprised that in a large commercial town like Greenock electricity had not already been established, and when the argument was pressed upon them that the Corporation were the owners of the gas works, and that they must take great care of them, they were met by the retort that the universal experience of the Board of Trade was that wherever electricity was introduced it did not prejudicially affect the Gas Trust, but, on the contrary, both lights seemed to develop and pay corporations. There was no reason why they should have fresh taxation placed on the ratepayers, but if Greenock was to take its place along with other large towns, the time had arrived for the installation being formed. The matter was remitted to the Sub-Committee on Electricity to report their views on the best method of carrying out the details of the proposed installation.

Hertford.—The Corporation is inviting offers for a lease of its electric lighting order from persons competent to carry out same. See our "Official Notices" this week for particulars.

High Wycombe.—The Town Council had before it last week a report by the Electric Light Committee on general matters regarding the undertaking of the Electric Light Company. The Committee is to draw up a plan of proposed positions of public lamps.

Huddersfield.—The Hill Top Co-operative Society, Paddock, Huddersfield, have resolved to obtain estimates for the lighting of the premises by electricity. The Board of Trade has given formal permission to the Huddersfield Corporation to alter the standard pressure upon the low tension electric lighting mains in the central portion of the town from 100 to 200 volts.

Ilfracombe.—The Ilfracombe Electric Lighting Bill has passed through Committee of the House of Commons.

Kingswinford.—The Board of Trade has issued a provisional order to the District Council. The Bill has yet to be confirmed by Parliament.

Leeds.—The Local Government Board has intimated that the provisional order enabling the Corporation to issue stock, irredeemable or otherwise, for the purchase of the undertaking of the Yorkshire House-to-House Electricity Company had been made, and would shortly be submitted to Parliament for confirmation.

Lymington.—Messrs. Edmundson's Electricity Corporation have placed a proposal before the Town Council regarding electric lighting. They propose applying for a provisional order, and, with the consent of the Council, are ready to start work at once. The public lighting would be done at 4d. per unit, and private lighting at 7d. A special committee has been going into the matter, and was to report to the Council this week.

Lynn.—The whole Council in committee recommended this week that the offer of Prof. Robinson to prepare drawings, specifications, &c., and supervise the electric lighting installation, should be accepted. They also recommended that another site besides that near the walks should be selected for the central station works. The proposals were adopted.

Maidstone.—The Electric Lighting Committee has further considered the question of a combined dust destructor and electric lighting station, and is anxious for more information before reporting definitely to the Council. A small Sub-committee has been therefore appointed to visit Norwich and Leyton with a view of inspecting the works at those places.

Margam.—The Electric Lighting Bill has been certified for second reading.

Melbourne.—The Lighting Committee of the City Council recommends the purchase of the undertakings of the electric lighting companies. The Electric Light and Power Act provides that each company shall receive 10 per cent. beyond the total value of its undertaking. The assets of the two companies are roughly estimated at £150,000.

Metropolitan Asylums Board.—At the fortnightly meeting on Saturday, a letter was read from the Local Government Board asking for information as to the grounds which have led the managers to decide to substitute electric light for gas at the Northern Hospital at an estimated cost of £10,350. The Board also asked for a description showing the extent of the scheme. It was resolved to refer the letter to the Works Committee for consideration.

Newport.—The Electricity Committee on Tuesday morning decided to recommend the Corporation to sanction the purchase of emergency plant, in order to meet the demand for light which will have to be faced in the autumn. The present plant is already overloaded, and as the demand shows a steady increase, the works will be inadequate to supply light for next season even for the present area. The Chairman (Alderman Moses) and the consulting engineer (Mr. R. Hammond) have made inquiries and inspected plant, and the Committee have adopted their suggestion that to meet the emergency second-hand Brush plant, which can be obtained for £1,150, after being put in thorough repair, shall be purchased. As the new plant cannot be delivered in time to meet the necessity, it is necessary to obtain some additional plant, and in the opinion of the Committee this is the best that can be done.

North Berwick.—Prof. Kennedy recently wrote to the Town Council regretting that he would be unable, owing to pressure of business, to give time for a report on electric lighting at present, and recommending the firm of Messrs. Burstall & Monkhouse, Westminster. After discussion it was agreed to ask Messrs. Burstall and Monkhouse to report.

Nottingham.—A reduction is to be made in the charges for electrical energy from June 30th. The Corporation will in future charge for lighting purposes for any quantity not exceeding the equivalent of 100 hours per quarter 4d. per unit, and 2d. afterwards. For power purposes it will be 2d. per unit for four hours' average daily use, and 1d. beyond.

Ossett.—The new mill premises of Mr. R. E. Phillips, mungo manufacturer and rag merchant, at Gedham, have been lighted electrically. The plant comprises a Robey 30-H.P. nominal horizontal engine, and a multipolar dynamo, capable of supplying current for about 200 16-C.P. lamps, and a 12-H.P. electric motor. At present just over 100 lamps are installed. The lights are arranged in groups of eight, and all circuits controlled by single-pole switches. The premises have been fitted up with telephones on the "Ennunciator" plug-board system. The work has been carried out by Mr. Walter Robb, of Ossett.

Paris and Berlin.—Some recently published statistics show that in Berlin there are some 300,000 16-C.P. incandescent lamps installed, besides several thousand arc lamps. The length of mains is about 186 miles, and the power developed is about 28,000 H.P. There are also some 1,600 motors, taking 6,450 H.P. The price for lighting is 7·5d. per kilowatt-hour, for power 2d. per kilowatt-hour. Paris demands some 25,000 H.P. for about 418,000 lamps of 10 candles, and 7,448 arc lamps, with about 240 miles of mains. The motors number 513, requiring 1,940 H.P., and the price is 11½d. per kilowatt-hour.

Peterborough.—The Peterborough Electric Light and Power Company is prepared, if the Council does not commence to put its electric lighting order into effect by June, to make application for the order to be revoked. As, however, Mr. Gill, the engineer, has prepared plans for the proposed electricity works in Queen Street, the site having been already purchased by the Corporation, the company's application will probably be unnecessary.

Petersfield.—For some time past the Petersfield Urban District Council (Hants) have had under discussion the advisability of applying for a provisional electric lighting order. At the last Council meeting on the 19th inst. it was decided to communicate with different firms of electrical engineers to ascertain the terms for advice and report as to the practicability of an electric lighting system for the town.

The District Council has referred a proposal that it should apply for an electric lighting provisional order to the Lighting Committee.

Plymouth.—The work of laying the electric cables is going on in the principal thoroughfares.

Portsmouth.—It is stated that a scheme has now been prepared for introducing incandescent electric lighting into rather more than 100 streets in which gas is now the sole illuminant. The idea is to utilise the present gas standards, to the top of which two incandescent lamps would be affixed. It is estimated that the cables could be laid, the lamps converted and the lights supplied on precisely the same terms as is now charged for gas. It is further understood that the balance-sheet of the Electric Light Committee, which will shortly be issued, is likely to be more satisfactory than expected. Owing to the engineering strike last year, the new works were delayed for seven months, and the Committee were put to great expense in hiring machinery to keep the station in full operation. The surplus over all liabilities will not reach £1,000.

Salford.—At last week's Council meeting, Mr. A. Haworth, chairman of the Electric Light Committee, moved the adoption of plans for the erection of a new generating station on land in Strawberry Road, at an estimated cost of £28,161. He said they were considering plans for the application of electric traction to the tramways, and as they had already gone as far as they dared in supplying the current to consumers, they had to decide between extending the old station and erecting a new one. He believed that, unless perhaps for the first year, the proposed new station would not entail any charge on the rates, for as soon as they commenced working, interest and sinking fund would be provided out of the revenue. The electricity works were making gratifying progress, and the loss during the past year had been reduced by £900. The motion was seconded by Mr. Boys and adopted.

Sheffield.—The residents have this week been voting on the electric lighting question. The papers were collected on Monday. The voting was as follows:—For Corporation purchase, 28,130 votes; against ditto, 1,965 votes; majority, 26,165 in favour.

In accordance with the resolution of the City Council, an expert inspection of the water reservoirs was commenced on 23rd inst. by Mr. Frederick Nell, of London, with a view to advising the Council upon the question of utilising the water-power available for generating electricity.

Southampton.—The Court of Arbitration appointed to decide what compensation shall be paid by the Corporation to the Southampton Tramways Company for their undertaking, held its first sitting on 14th inst. to fix the course of procedure. Sir Henry Oakley sat as umpire, Messrs. G. Hopkins, C.E., and J. Kincaid, C.E., as arbitrators, and Mr. W. Phipson Beale, Q.C., as legal assessor.

Stockport.—The Gas and Electric Lighting Committee received 54 applications for the post of clerk of works for the electricity undertaking. They are being considered, and will be dealt with this week.

Stonehouse.—The District Council has disapproved of plans submitted by a company for the erection of an electric lighting station at the corner of Phœnix Street.

St. Pancras.—Mr. H. J. Menzies, chairman of the Electricity and Public Lighting Committee during the past year, was elected chairman of the Vestry at the first meeting after the election on Wednesday evening. It was decided, on the recommendation of the Electricity Committee, to sanction the expenditure of £414 for the installation of a coal conveyer at the King's Road station, in order to deal with the increasing output. The resignation of Mr. J. C. A. Ward, inspector of works, who has obtained an appointment under the Corporation of Glasgow, was accepted, and it was resolved to give him a testimonial under the seal of the Vestry.

Tynemouth.—The Tynemouth Aquarium is being fitted up by its new proprietor with a complete electric light and power installation, including engines, dynamos, motors, and boilers. The work has been placed in the hands of Messrs. W. Dalzell & Co., electrical engineers, of Newcastle. The Aquarium will be lighted by 14 arc lamps, each of 2,000 C.P., besides numerous smaller lamps.

Winchester.—The directors of the Winchester Electric Light Company announce that a supply of current is now available. They are prepared to fit up any premises on the free wiring principle. No charge is to be made for any current used prior to July 1st.

A committee recommends the Council to accept the tender of the Gas Company for lighting the streets of the city for a further period of three years. This company's offer amounts to £1,240 per annum, while that of the Electric Lighting Company is £1,313.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackpool.—The report has been issued of the electric tramway for the year ending March 31st, 1898. The estimated receipts for the year were £14,575; they actually were £15,496—an increase of £921. The estimated expenditure was £9,776, and the actual £10,206, increase £360. This increase includes £119 as the tramway share of the expenses of the Continental deputation. The gross profit is £5,290. Deduct from this £2,984 as interest and sinking fund, and there is a net profit of £2,306. Deduct again 1 per cent. for depreciation on a capital of £58,900, which is £589, and we get £1,717 as the available balance of profit for the year, a sum equal to 1¼d. in the £ on the rates. 2,279,209 passengers were carried—an enormous increase on the previous year. The growth of the tramway receipts is as follows:—1895-6, £9,869; 1896-7, £13,223; 1897-8, £15,496. In the last report, for 1896-7, although the receipts had grown by £3,500, the profits fell off by £360. This year they have jumped up from £230 to £1,717. The car miles run for the year ending March 31st of the present year were 220,818. The receipts per car mile were 16·9d., and the expenses 11·1d., giving a profit of 5·8d. per car mile. The trams cost for electrical energy, coal, water, &c., £2,172; wages, £3,120; channel repairs, which were kept down in view of the overhead system being adopted, £658; repairs to motors and gearing, £2,145, and to cars and wheels, £675.

Brighton. — At last week's Council meeting the Works Committee's report was adopted, in which it was recommended that 2,100 feet of the electric railway lying between the Camelford Street groyne and the east end enclosures should be carried on piles on the seaward side of the new breastwork. The estimated cost to Mr. Volk is £1,500 additional. This was agreed to, and it was also resolved that the Corporation should grant Mr. Volk a lease for the period of 21 years of the arch now in his occupation, and a license for the same period for the railway, at a rent for the whole of £120 per annum. The license to be subject to conditions providing for its determination in the event of its being judicially decided that the railway is a nuisance, annoyance, injury, or danger to the public. Mr. Volk was to maintain the railway, which, at the expiration of the 21 years' lease and license would become the property of the Corporation. A table showed the compensation to be paid to Mr. Volk in the event of the Corporation at any time taking possession of the railway at six months' notice. The scale ranged from £3,000 in the first year, to £200 in the 21st year. The terms also prescribed that the maximum fare should be 2d. for the single journey, and 3d. for the double journey.

Bristol.—A requisition on behalf of the Corporation of Bristol for leave to withdraw their opposition to the Bristol Tramways (Electrical Power, &c., Bill) has been deposited in the Private Bill Office of the House of Commons.

Cardiff and Penarth.—A deputation from the Penarth Chamber of Trade will support the Cardiff and Penarth light railway scheme at the Board of Trade inquiry on June 1st.

Clacton-on-Sea.—The Coast Development Company has been formed with a capital of £500,000 for various purposes, one of which is to enlarge the pier at Clacton-on-Sea, and to construct an electric tramway. The company proposes to also put down an electric line at Walton-on-the-Naze.

Dundee-Broughty Ferry.—Mr. R. O. Ritchie, of Messrs. Greenwood & Batley, electrical engineers of Leeds, who are the promoters of the electric light railway scheme to connect Dundee and Broughty Ferry, paid a further visit to Dundee last week. The *Dundee Courier* interviewed him and he made some general comments regarding the scheme.

Dublin.—Rapid progress is being made with the electric tramway lines in the city, and it is expected that in about four weeks the connection between O'Connell Street and Haddington Road will be completed. The trip can then be made direct from Nelson's Pillar to Dalkey without changing the car.

East London (South Africa).—The East London Town Council have prepared specifications for tramlines and electric light, and, we understand from a contemporary, that tenders are being called for in England and in the colony.

Gillingham.—At the meeting of the Gillingham Urban District Council on the 19th ult, the clerk read a letter from Messrs. Ashurst, Morris, Crisp & Co., to the effect that the promoters of the electric trams were prepared to proceed with the remainder of their scheme for running trams throughout the Gillingham district, and with reference to the proposed improvements in the High Street, they were prepared to contribute £2,000 towards the cost. The question of providing weekly tickets for workmen at a cost of 9d. for 24 journeys was also discussed, and the promoters propose to provide two special trams on each route for the workmen at stated hours during the day. The Civic Union sent a copy of a resolution passed at their last meeting, calling upon the Council to oppose the scheme, and take the necessary steps for laying down electric trams of their own. Several members of the Council were in favour of the promoters carrying out their scheme in its entirety for the whole of Gillingham. There was a great deal of discussion on the subject, and the whole matter was eventually referred to a sub-committee. The adjourned public inquiry into the scheme will take place on June 4th, and there is very little doubt that although strong opposition will prevent the electric trams being adopted throughout the whole of the combined districts of Rochester, Chatham, and the neighbourhood, still the trams will appear at Gillingham, and most likely through Old Brompton, and from a part of Chatham to Luton.

Glasgow.—The laying of plant for the introduction of electric cars upon the Springburn route proceeds fairly satisfactorily but, adds a local paper, not quite so quickly as some anticipated The Tramways Committee is stated to have hopes of opening the route from Mitchell Street under the trolley system by the Fair holidays. The lines, which have been relaid, are now pretty nearly completed. The poles, which were commenced to be erected at the Springburn end, are gradually planted citywards. The engines and dynamos are now complete at the works, and some of them are being delivered. The carriages are being constructed at the Corporation's own workshops, and are well forward. One of the large sheds at Springburn is being altered and made suitable for the power house. Good progress is being made with the lowering of the road under the railway arch at St. Rollox.

Hastings.—Mr. Murphy appeared before the Town Council on 19th inst. and explained his proposed light electric railway scheme for Hastings. He would put down a line of 3 feet 6 inches gauge, with 18 cars, and his company would agree to a 25 years' lease. The Corporation could use the overhead wire standards for the purpose of electric lighting. Mr. Murphy's interview lasted some considerable time, and numerous questions were put and answered. In a subsequent discussion the Council went into various points in connection with the matter, and ultimately passed a resolution supporting the Hastings, Bexhill, and district light railways (electric) scheme, which is Mr. Murphy's proposal. A committee is to go into the matter of terms with the promoters and report on June 3rd.

Huddersfield.—The County Borough Council has instructed the Tramways Manager and Borough Electrical Engineer to prepare and submit a report as to the application of electric traction on one or more of the sections of the present steam tramway system, having regard to capital expenditure and the present rolling stock.

Hull.—The ceremony of laying the first rail of the electric tramways is expected to take place on June 9th. The city engineer has reported on the subject of the overhead construction. A question had arisen, he said, whether the poles for carrying the trolley wires on the Holderness Road route should be placed on the north or the south side of the road. It was being arranged to place the poles on the right-hand side going out of the town on the Hessle Road, Anlaby Road, Spring Bank, and Beverley Road routes, and also on the right-hand side coming from Nelson Street on the Old Town route If it were not for the fact that through cars might be run from either the Hessle or Anlaby Road on to the Holderness Road (if Savile Street is carried straight through to St. John Street) the right-hand side going out of the town would no doubt be selected for the Holderness Road route; but in view of the possibility of through cars being run, he (the engineer) thought it desirable to adopt the left-hand, or north side, for the route. The only disadvantage which could arise by fixing the poles on the north side of the route appeared to be that unless the lines were arranged so that the cars would run straight through, by connecting St. John Street to Savile Street, or otherwise, a car could not, in case of emergency, be transferred to or from the Holderness Road route without turning it round; but if a double junction were provided at some suitable point on the system, the cars could be turned round if the necessity for doing so arose. It was resolved to adopt the engineer's suggestion with respect to the poles in Witham.

The Tramway Deputation Sub-Committee has been authorised to advertise for tenders for electric cars to run with those already ordered.

Italy.—It is reported that the Rete Adriatica Railway Authorities are considering the question of introducing electric traction on the railways between Lecco and Sondrio (79 kilometres) and between Colico and Chiavenna (26 kilometres). The water power of the River Adda would be utilised in generating the necessary electrical energy.

Kidderminster-Stourport. — This electric tramway scheme which was described in our last issue, was passed by the Board of Trade inspector on Wednesday, 18th inst. Sir F. Marindin and Major Cardew were the officials who inspected the line. In the matter of speed it was considered that 8 miles an hour would not be too great a pace in the streets, except Foundry Street, Stourport, and

at certain narrow parts in Kidderminster, where 5 miles must be the maximum. On the open road between Kidderminster and Stourport a rate of 12 miles would be allowed. The inspectors were met by District Councillors, Mr. A. Dickinson, and representatives of the contractors. Sir Francis gave permission to commence running at once. He made suggestions with reference to the stopping places, but the permanent way and power plant were perfectly satisfactory.

Liverpool.—Notwithstanding that the Council at its last meeting declined to pass the recommendation of the Tramways Committee to accept the tender of Messrs. Willans & Robinson, to supply two compound engines and dynamos at the price of £6,530 each, and a triple expansion engine and dynamo at the price of £6,939, we learn from the *Liverpool Daily Post* that the committee at a special meeting on the 13th again passed the recommendation, which will, therefore, again come before the Council in its original form. An amendment was moved by Mr. Rutherford, and seconded by Mr. Beaver, "That in view of the fact that no engine of the type recommended has hitherto been used for power, this committee consult Dr. Hopkinson thereon prior to issuing the order." This was rejected by a large majority.

Llandudno.—At last week's Council meeting various small main extensions were authorised. The question of the application of the Llandudno and Colwyn Light Railway Syndicate, and the letters of the Simplex Company and Messrs. Kingsland and Edwards was discussed in a report by Mr. A. H. Preece. Mr. Preece said that it was to be regretted that the establishment of tramways in Llandudno could not be undertaken by the Council. However, as it had been necessary to arrange matters with the Light Railway Syndicate, the Council were only safeguarding their own interests by insisting upon the supply of energy remaining in their own hands. The question of the powers of the Council to supply the syndicate with energy in these outlying districts was a legal matter which he was unable to enter into. At the same time he saw no reason why it could not be suitably arranged temporarily with the chief parties concerned if a permanent arrangement were not possible. As regards the terms in the agreement for the supply of electrical energy, the following heads were suggested:—(1) The syndicate should guarantee the use of a minimum quantity of energy per annum. (2) The Council should agree to deliver the requisite electric current at constant pressure to a switchboard in the generating works, and all work, consisting of feeders, &c., beyond this board should be erected by the syndicate. (3) The syndicate to fix the maximum quantity required at any moment, and any increase to be subject to not less than nine months' notice. (4) The Council should agree to penalties in case of failure to supply energy, and fix fall in pressure below a fixed point, subject to causes beyond the Council's control. (5) The price to be mutually agreed upon subject to modification at the end of the second season, and every three years after. (6) The energy supplied to be measured by approved meters, and any difference to be settled by arbitration. (7) Payments to be made every month. The question of the prices to be charged was the only point which may present difficulties in settlement. He suggested that the Council should consider a scheme by which the payment should depend upon the interest, sinking fund, and depreciation of the cost of the extra plant required, and upon the actual working cost of the power generated. He anticipated that the extra capital expenditure in the generating works would not exceed £5,000. In reference to the overhead and underground system, Mr. Preece reported to the effect that there are four principal systems, viz, the overhead trolley system, the underground slot system, the closed conduit system, and the accumulator system. The overhead system was undoubtedly the cheapest system to instal and to maintain. The rest were all expensive both in first cost and in maintenance. The only possible objection to the overhead system was the æsthetic one. There was not the least doubt that a properly designed overhead system, with handsome poles erected in the centre of the main road upon which the public lamps could be placed, might be made sufficiently attractive to overcome the objection raised to the system. The Council adopted the recommendations.

Lord Jersey and Colonel Boughey held a light railway inquiry at Colwyn Bay on Friday last. The scheme was supported by Llandudno and Colwyn Bay District Council and the Conway Corporation, while Lord Mostyn and other private parties opposed. After two hours' evidence the promoters approached Lord Mostyn, and he withdrew his opposition upon terms. The Commissioners will recommend the scheme.

London.—Arrangements are being pushed forward with a view to providing the northern suburbs of London with increased facilities for getting cheaply and quickly into the central district. The scheme, says the *City Press*, is being prepared by the Metropolitan Tramways and Omnibus Company, and, if the authorities allow the programme to be carried out in its entirety, something like 30 miles of rails will be laid, at a cost of about £500,000. The new scheme is styled the "London, Barnet, Edgware, and Enfield Light Railways," and by means of electricity, on the overhead system, it intends to provide cheap and quick transit for passengers and parcels. A great part of the district affected is at present only served by the Great Eastern and Great Northern Railways, and the proposal has been warmly received in the localities that will be benefited. Owing to the fact that the London County Council are committed to a policy of developing the tramway system in their own borders, the new railways will have to commence at various points outside the county boundary. These will not be isolated points, but in most cases will practically be junctions with the main routes of the North Metropolitan Tramways Company. For instance, the latter runs cars to Wood Green, and from this point the new company will continue along the high road to Enfield, *viâ* New Southgate, Palmer's Green, Winchmore Hill, and Bush Hill. From Enfield a branch to the right will connect with Ponder's End, to which the North Metropolitan Company already convey passengers. From the base at Wood Green, also, a connection with Tottenham will be made, joining on to the existing tramway to Ponder's End. A third line from Wood Green will run *viâ* Friern Barnet and Whetstone to Chipping Barnet. From Whetstone it will be possible to get south-east through East Finchley and North End to Highgate; and south-west to Hampstead, Child's Hill, and Cricklewood; Finchley and Church End being served *en route*. Cricklewood is to be the centre of a connection between the Marble Arch and Edgware, the first part of the journey being in omnibuses run by the new company as feeders to the western branch of their system.

London United Tramways Bill.—The adjourned report of the Highways Committee of the London County Council in reference to the London United Tramways Bill, was again brought forward at last week's Council meeting. It will be remembered that the committee suggested that the Council should support its petition against the Bill by evidence before the Select Committee. Earl Russell had given notice of an amendment that the Council should offer no opposition to the use of overhead traction in the Uxbridge Road, but this was not proceeded with owing to the withdrawal of the recommendation by the chairman of the committee. Mr. J. W. Bean (chairman of the committee) asked permission of the Council to withdraw the paragraph, the committee being of opinion that they would be touching upon the scope of the Select Committee. The latter, he remarked, were proceeding on the lines of testing that clause of the Bill, the object of which was to deprive the Council of its power of veto in regard to mechanical traction. The question would, however, come up again, and hence he desired to withdraw the recommendation. The Council then consented to the withdrawal of the paragraph.

Norwich.—The Norwich Electric Tramways Bill came last week before the Standing Orders Committee of the House of Commons, on the petition of the promoters to be allowed to insert an additional provision giving them power to widen streets for the purpose of the tramways. The committee allowed the additional provision to proceed.

When the electric tramway Bill came before the Parliamentary Committee on 23rd inst., there was a strong opposition against running the trams along Surrey Street, and, in consequence, this portion of the scheme was struck out.

Redditch.—The District Council has given assent to a proposal made by Messrs. Coleman & Whiteley, solicitors, on behalf of a syndicate to lay down a light electric railway from the railway station, Redditch, through the populous districts of Headless Cross and Crabbs Cross to Astwood Bank, a distance of three miles.

Richmond.—The Duke of Cambridge, Lord Charles Beresford, the Earl of Dysart, Lord Perth, and others are opposed to the Kew and Hampton Court electric tramway scheme.

Richmond and Hampton Court.—At a meeting of the Kingston-on-Thames Town Council on Tuesday last week, it was agreed to dissent from the proposals to construct a light railway for passengers through the borough boundaries in connection with the scheme to connect the West End with the district by trams worked on the trolley system. The General Purposes Committee having framed a resolution to this effect, Councillor Lynes said there was undoubted need for better communication, seeing that Kingston was fast approaching the dimensions of a county borough, but he thought that a system of tramways under their own control would not only be a source of revenue, but would utilise the day load from the Corporation's electric lighting station. Alderman J. B. Walker, J.P., said that if the present light railway scheme were carried through, the Corporation would not have the option to purchase the undertaking, as under the Tramways Acts. He thought the Corporation ought not to lose control of their roads under any circumstances, and that the proposed alteration of the level of the road beneath the railway bridge in Richmond Road would make that place even more dangerous than it was already. Councillor Horsfield pointed out that Kingston had made a great mistake 30 years ago in refusing to allow the L. & S. W. R. Company to bring their main line into the town. He thought that the matter should be fully discussed at a special meeting, and said that he had seen on the Continent that wherever such railways had been made, the country round about them was in a very flourishing state. The Mayor (Councillor W. Hart), in putting the committee's recommendation, said that in the cases cited by Councillor Horsfield, the lines were worked either by the State or the municipal authorities. The resolution was carried *nem. con.*

Rowley Regis.—The District Council had a brief discussion last week regarding the scheme of electric light railways brought forward by a company, and it was resolved to support the scheme. It was stated that the Dudley Corporation was promoting a tramway scheme which it would like to run through Rowley Regis. The District Council of the latter place, however, thinks the matter would be more satisfactory if in the hands of a company.

Spen Valley.—It is extremely probable that within the course of a very short time some important developments will be made in the Spen Valley of Yorkshire in regard to the use of electricity as a motive power. An agitation has been proceeding sometime for placing the towns of this populous district more in touch with each other by means of trams. The matter is not only being discussed by people living in the towns, but by gentlemen connected with tramways in other towns. A director of a Midland electric tramways company visited the district, and after inspecting

the various routes suggested promised to report to his company. He also stated that he would come over again and bring the company's engineer with him. The managing director and engineer of the British Electric Traction Company has also visited the district several times recently. The latter company are also prepared to lay down the line if there is a prospect of a reasonable return for the outlay, and providing that there is no opposition from local authorities. The scheme is an extensive one and would be about 11 miles in length. It is proposed that the line should proceed by way of Halifax Road, Berkdale Road, Starncliffe Road, White Lee Road, and then through Heckmondwike to Liversedge, and forward to Cleckheaton. The line should then proceed to Gomersal and effect a junction with the existing tramway from Dewsbury on which, however, steam power is used. The existing tramway from Gomersal, it is thought, could be purchased, and, in fact, some of the gentlemen connected with the tramway company have been approached and were not disinclined to sell out. By this circular route the trams would pass through a district with a population of over 100,000. It is stated that the corporations and district councils far from opposing the running of trams through these districts would do all they could to encourage.

St. Petersburg.—The Helios Company has offered to introduce electric traction on the St. Petersburg tramway on the following conditions:—The three existing lines to be converted into two lines of 4·5 and 7·3 kilometres in length. The cars to be worked with accumulators, and also to be lighted, heated, and braked by electricity. The fares for each line to be five and three kopeks. A three minute service to be run during the day, and a five minute service in the evening up to 12 o'clock. If the city should wish to work the line itself, the Helios Company asks to construct the line and the cars and also to supply the electric energy. After taking over the installation, the city will be asked, over and above the payment for the energy, to pay to the company 7 per cent. per annum on the installation capital for 40 years. But in case the city should not take over the undertaking, the Helios Company offers to work the undertaking for 40 years and pay the city on the net income annually: first, 7 per cent. on the installation capital; second, 1 per cent. of the capital for maintenance and the reserve fund. After subtracting the said 8 per cent., 30 per cent. of the remainder of the net income falls to the Helios Company, while the remaining 70 per cent. goes to the city, a minimum sum of 200,000 roubles yearly being guaranteed. Should the proposal be accepted without delay, electric traction could be introduced about September 1st. Further proposals are being made to take over the much more extensive network of the second horse tramway company.

Teeside.—We understand that the Middlesbrough, Thornaby, and Stockton electric tramway, which has been put down by the Imperial Tramway Company is now completed, a trial trip over the whole course from Norton to North Ormesby and Linthorpe being made by local pressmen and the officials of the company on Monday last. The run was not a formal opening, but merely a trial to see that the gauge was true, the points properly adjusted, and everything satisfactory.

Worksop to Newark.—It is stated that the Railway Corporation of Great Britain (the promoters of the above scheme) have decided to defer their application to the Light Railway Commissioners for powers to construct this proposed electric line until next November.

TELEGRAPH AND TELEPHONE NOTES.

The Gotland Cable.—The cable steamer, *H. C. Oersted*, which left Henley's Telegraph Works at North Woolwich on the 21st inst., with the Gotland cable on board, arrived at Copenhagen on the 24th inst. and proceeded at once to Ahr, from which point she will start laying the cable. This is the second Gotland cable made and laid by Messrs. Henley—the first, laid many years ago, being still in good condition.

Interruptions of Cables to the Cape.—Since March 4th, the date of the repair to the cable between Aden and Zanzibar, on the East Coast of Africa, the interruptions of the cables to the Cape have been almost entirely confined to those on the West Coast. The record is as follows:—

	Down.	Repaired.
St. Thomé-Loanda ...	March 17th ...	March 19th.
Sierra Leone-Accra ...	April 9th ...	April 19th.
Cape Town-Mossamedes	„ 14th ...	May 5th.
Benguela-Mossamedes ...	„ 20th ...	May 5th.
Kotonou-San Thomé ...	„ 27th ...	Still interrupted.
St. Thomé-Loanda ...	May 4th ...	May 14th.

Thus from March 17th up to the present time, with the exception of 20 days, the West Coast route to the Cape has been totally interrupted; two of the main cables being down together during a portion of this time, and three of the main cables being simultaneously unavailable during another portion of the period mentioned. It is fortunate that during this period the only cable interrupted on the East Coast was that which runs from Delagoa Bay to Port Natal, which was useless on two occasions, during which, however, communication with the Cape was not entirely cut off, as telegrams for Cape Colony could still pass over the Transvaal landlines. As public confidence in Mr. Kruger's administration seems to be reviving, the fact that all telegrams for Cape Colony have occasionally to pass over the Transvaal landlines need not arouse such anxiety as would have been natural during the recent misunderstanding at Johannesburg.

Pacific Cable.—The *Critic* says that the events of the Spanish-American war, more especially the cable-cutting tactics of the opposing forces, have impressed upon Canadians the value of an open cable communication in time of war, and renewed interest has been aroused in favour of the Pacific Cable scheme. The general opinion is that Canada should take the initiative in the movement, especially as she contributes so little to the defence of the Empire. It is, therefore, being advocated by prominent Canadians and Imperialists, among others Doctor Parkin, that a joint resolution from both Houses of the Canadian Parliament be addressed to the Home authorities, asking that a Royal Commission should be at once appointed, with full powers to arrange for the construction and operation of a cable from Canada to Australia. It is also proposed that the Commission should assign the fair proportion of cost to be borne by the different parts of the Empire, the initial cost to be guaranteed by Canada. As Sir Sandford Fleming has proven, to his own satisfaction at least, the enterprise would pay from the start, and it would at least be an exhibition of our national pluck and patriotism.

Shallow Water Cables.—On many occasions we have pointed out the risks which attend telegraph cables lying in shallow water, even when no organised attempt is made to destroy them. This opinion is quite warranted by experience, but in time of peace the attention of the public is not drawn to such occurrences, as their interests are not sensibly affected. The extent of the damage to which we refer may be gauged from the following extract from the abridged report of the Great Northern Telegraph Company:—"The state of the cables in Europe has not been satisfactory during 1897, especially towards the end of the year. No fewer than 11 of the cables have been interrupted, the total number of interruptions being 32. These have nearly all been due to injury caused by the fishing vessels, especially by the steam trawlers, which are spreading more and more, not only over the North Sea, but also in the Skager Rack and Kattegat. Even the strongest cables cannot withstand the rough treatment to which they are exposed, and we are, therefore, now considering the advisability of making an alteration in the type of cable so as better to protect them against the attacks of the trawlers." This experience goes to prove the ease with which shallow water cable can be interrupted, as along the track of these cables in the North Sea, the depth of water is generally less than 50 fathoms. It is clearly against the interest of the trawlers to fall foul of a strong telegraph cable, as by so doing they run the risk of losing their trawl nets and lines, otherwise the interruptions referred to would be much more frequent. The lesson to be gathered from this is of especial interest to us now when the vital importance of unimpaired telegraph lines is so clearly illustrated in the case of the war between America and Spain. With this lesson before us we would again strongly insist on the danger to which the cables connecting England with Gibraltar, Malta, West Africa, the Cape, Zanzibar, Mauritius, Egypt, India, the Straits Settlements, China, Australia, and New Zealand are exposed. If we except Continental landlines, and also an impracticable route *viâ* America, the West Indies, the South American Republics and Brazil, we are utterly and entirely dependent for communication with the colonies above-named, on a single group of three cables, which, starting from Cornwall, run southwards to landing places in Spain and Portugal, all lying for a distance of about 150 miles from England in water which is not 100 fathoms in depth. These cables lie within easy reach of the French naval headquarters at Brest, and however efficiently the mouth of the Channel might be patrolled by English war vessels, the risk of interruption, and the disastrous consequences which such interruptions would entail, are much too serious to be any longer regarded with levity.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	**April 6th, 1898 ...**	**...**
West Indies—		
St. Croix-Trinidad ...	**Nov. 30th, 1896 ...**	**...**
Amazon Company's cable—		
Parintins-Itacatiara ...	**May 5th, 1896 ...**	**...**
Obidos-Parintins ...	**Dec. 7th, 1896 ...**	**...**
Cable beyond Gurupa ...	Nov. 4th, 1898 ...	
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Bolama-Bissao	April 12th, 1898 ...	...
Maranham-Para	„ 17th, 1898 ...	...
Kotonou-San Thomé ...	„ 27th, 1898 ...	May 25th, 1898
Hong Kong-Manila	May 3rd, 1898 ...	...
Monte Video-Rio Grande ...	„ 5th, 1898 ...	May 18th, 1898
Aden-Zanzibar	„ 24th, 1898 ...	May 25th, 1898
Landlines.		
Trans-Continental line beyond Masol	**March 12th, 1896 ...**	**...**
Cartagena-Barranquilla ...	**July 4th, 1896 ...**	**...**
Saigon-Bangkok	May 20th, 1898 ...	May 21st, 1898
Venezuela landlines	May 20th, 1898 ...	May 23rd, 1898
Majunga-Tananarive... ...	May 23rd, 1898 ...	...

Teneriffe-Cuba Cable.—A despatch dated April 4th, from H.M. Chargé d'Affaires at Madrid to our Foreign Office, says that the Minister of Colonies is authorised to announce a public auction for the concession for the construction and establishment of a submarine telegraph cable between Cadiz, Santa Cruz of Teneriffe, the Island of Vieques (near Puerto Rico) and Havana.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast.—June 6th. The Harbour Commissioners are inviting tenders for the supply of three belt-driven, continuous current, series wound dynamos, to give 15 amperes, 2,850 volts, at 800 revolutions per minute, for 18 hours' continuous running without undue heating. Harbour engineer, Mr. G. F. L. Giles, from whom particulars may be obtained. See our "Official Notices" for particulars.

Belgium.—June 10th. The Provincial Government Authorities in Brussels are inviting tenders for an installation of electric lighting in the Bibliotheque Royale, in the Place du Musée, Brussels. Tenders to be sent to Le Gouvernement Provincial, Rue des Augustins, 17, Brussels, from whence particulars may be obtained on payment of 4s. 6d.

Belgium.—May 31st. The Municipal Authorities of Ixelles, a suburb of Brussels, are inviting tenders until May 31st for the exclusive concession for the supply of electrical energy for lighting and power purposes during a period of 26 years, that is, to September 1st, 1924. Tenders to be sent to the Secretariat de la Commune d'Ixelles, Brussels, from whence particulars may be obtained.

Bournemouth.—June 20th. The Corporation is inviting tenders for the supply, &c., of cables, arc lamps, incandescent lamps, wiring, switchboards, fittings, &c.; also steam dynamo, &c. Particulars from the borough engineer, Mr. F. W. Lacey, also see our "Official Notices" this week.

Bury St. Edmunds.—June 13th. The Corporation invites tenders for the supply and erection of Lancashire boilers, three 60-kw. steam dynamos, transformer and booster, accumulators, street mains, and various other machinery and apparatus for the electricity undertaking. Consulting engineer, Mr. F. H. Medhurst, 13, Victoria Street, S.W. See our "Official Notices" May 13th.

Coventry.—June 7th. The Electric Lighting Committee invites tenders for electric mains, switchboards, arc lamps, posts and apparatus in connection therewith. For particulars of the several sections see our "Official Notices" May 13th. Mr. Gilbert S. Ram, city electrical engineer.

Hammersmith.—June 8th. The Vestry is inviting tenders for the supply and erection of a Ledward evaporative condenser and tanks, air pump, circulating pumps, and pipe work. Consulting engineer, Mr. A. H. Preece. See our "Official Notices" May 27th for particulars.

London.—June 21st. The London County Council is inviting tenders for engines, dynamos, accumulators, switchboards, feeders, distributors, and service mains and all accessories, to be fixed complete in buildings at the Crossness Outfall Works, near Erith, Kent. The L.C.C. also requires tenders for providing and fixing cables, wires, conductors, casing, pendants, brackets, and other fittings, columns, lanterns, lamps, switches, and switchboards, distributing boards, fuses, cut-outs, &c., necessary for the lighting by electricity of the Crossness pumping station and works, near Erith, Kent. Particulars of both contracts from the Engineer's Department, County Hall, Spring Gardens, S.W. See also our "Official Notices" May 27th.

Spain.—May 28th. Tenders are being invited by the Municipal Authorities of Plencia (province of Viscaya) for the concession for the electric lighting of the public streets of the town. Tenders to be sent to El Secretario del Ayuntamiento de Plencia (Viscaya) from whom particulars can be obtained.

St. Mary, Newington.—June 6th. The Vestry Electric Light Committee is inviting tenders for the supply and erection of engines, generators, and public lighting plant for the electric lighting scheme. Engineers, Messrs. Kincaid, Waller & Manville.

Sunderland.—May 27th. The Corporation invites tenders for the supply of steam and other piping, and water softener for the electricity works. Borough electrical engineer, Mr. J. F. C. Snell. See our "Official Notices" May 13th for particulars.

Taunton.—June 6th. The Corporation invites tenders for the supply and erection of engines and alternators in exchange for existing alternators and transformers, also alterations to switchboard, supply of rectifiers, &c. Messrs. Kincaid, Waller and Manville, engineers.

Victoria.—June 24th. The Council of the city of Hawthorne (Colony of Victoria, Australia) is inviting tenders for the supply and erection of buildings, boilers, engines, dynamos, transformers, mains, meters, arc lamps, poles; also running the plant for three years. See our "Official Notices" March 11th.

Watford.—June 8th. The District Council is inviting tenders for the erection of an electric light station adjoining the new sewerage works. Particulars from the architects, Messrs. Gordon, Lowther & Gunton, Finsbury House, Bloomfield Street, E.C.

CLOSED.

Aberdeen.—The Gas and Electric Lighting Committee recently authorised the electrical engineer to accept the offer of Siemens Bros. & Co., Limited, being the lowest, and amounting to £12,138, for the extension of the electric main cable to the harbour and the west end of the city. The committee recommended the borrowing of the further sum of £15,000 in connection with the electric lighting undertaking. The Council approved of these matters.

Chester.—The Council has accepted the tender of Messrs. Johnson & Phillips for the supply of 11 arc lamps at £136 odd.

FORTHCOMING EVENTS.

1898.

Friday, May 27th, at 5 p.m.—Physical Society, Burlington House. Agenda, "A Simple Interference Method of Reducing Prismatic Spectra," by Mr. E. Edser and Mr. Butler. "Some further Experiments on the Circulation of the Residual Gaseous Matter in Crookes Tubes," by Mr. Campbell Swinton.

At 9 p.m.—Conversazione at the Institution of Civil Engineers.

Thursday, June 2nd, at 8 p.m.—Chemical Society, Burlington House. Papers to be read:—"The Action of Ether on Organic Acids and on Carbo-hydrates in presence of Hydrogen Bromide," by H. J. H. Fenton, M.A., and Mildred Gostling, B.Sc.

Wednesday, Thursday, Friday, and Saturday, June 8th, 9th, 10th, and 11th.—Municipal Electrical Association Conference. See our "Notes" this week.

Thursday, June 16th, at 9 p.m.—Institution of Electrical Engineers' Conversazione at the National History Museum, South Kensington.

NOTES.

Electricity Direct from Water-power.—Herr Josef Popper describes in the *Electro-techniker*, May 15th, 1898, an ingenious method of obtaining electric currents directly from water-jets without the intervention of a hydraulic motor. He does not appear as yet to have reduced his invention to practical form, but it is just possible that there is something of practical value in it. It is a well-known principle that if a conductor moves so as to cut magnetic lines of force, that an E.M.F. is produced at right angles to the lines of force and to the direction of motion. If, now, a water-jet passes through a strong magnetic field—say between the poles of a strong electro-magnet—and the terminals of a circuit are brought in contact with the opposite sides of the jet, a current will flow through the circuit. Any number of jets may be used and connected up in series to obtain a useful electromotive force. The water of streams and waterfalls being by no means pure, will probably not have so high a resistance as to render the idea impracticable on that account—at least, so says the inventor. Popper thinks that steam and gas jets may be used in the same way, when currents of high tension and small quantity are required. This scheme, if practicable, would have the great advantage of reducing the cost and simplifying the construction of water-power installations. Popper states that he has been working at the idea since 1895.

"Scientific American" Naval Supplement.—The publishers of the *Scientific American* have very opportunely issued a "Special Navy Supplement," in which they include a brief history of the United States navy between the years 1883—1898 with the authorisations up to date. Any information respecting the fleet of either parties to the present war is of great interest, and the illustrations and general descriptive notes of the U.S. battleships, cruisers, monitors, gunboats, torpedo boats, &c., may be perused with profit. There are valuable tables of statistics, a coloured map of Cuba, and an explanation of the method of classifying the various types of war vessels. Messrs. Munn & Co., of 361, Broadway, New York, are the publishers.

Smoke Nuisance.—On Wednesday last week, at Bow Street, the Metropolitan Electric Supply Company were fined £5 5s. on one summons, and 6s. on each of 19 others, for having on 20 days between April 19th and May 11th allowed the chimneys at their Sardinia Street station to emit black smoke in such quantities as to cause a public nuisance. An order for the abatement of the nuisance was made by consent. The secretary of the company explained that, owing to the coal strike in South Wales, they were unable to get their usual smokeless coal.

Electric Railways in Europe. — Some interesting statistics showing development of electric railways in Europe within the last three years are published in the *Elektrotechnische Zeitschrift*, March 31st, p. 209. The statistics are arranged in two tables; one showing the extension in different countries, and the other the various systems in use. These tables are as follows :—

EXTENSION.

	Total length of track in kilometres. January 1st.			Total output of the power stations in kilowatts.			Total number of motor cars.		
	1898	1897	1896	1898	1897	1896	1898	1897	1896
Germany	1,138·2	642·69	406·4	25,868	18,963	7,194	2,493	1,631	857
France	396·8	279·36	132·0	15,158	8,736	4,490	664	432	225
Great Britain	157·2	127·42	107·3	6,843	5,156	4,683	252	200	168
Switzerland	146·2	78·75	47·0	3,828	2,622	1,559	237	129	86
Italy	132·7	115·67	39·7	6,570	5,970	1,890	311	289	84
Austria-Hungary	106·5	83·89	71·0	3,404	2,389	1,949	243	194	157
Belgium	69·0	34·90	25·0	2,415	1,220	1,120	107	73	48
Spain	61·0	47·00	29·0	930	600	600	50	40	26
Russia	30·7	14·75	10·0	1,270	870	540	65	48	32
Sweden and Norway	24·0	7·50	7·5	875	225	225	43	15	15
Servia	10·0	10·00	10·0	200	200	200	11	11	11
Bosnia	5·6	5·60	5·6	75	75	75	6	6	6
Roumania	5·5	5·50	5·0	140	140	140	15	15	15
Holland	3·2	3·20	3·2	320	320	320	14	14	14
Portugal	2·8	2·80	2·8	110	110	110	3	3	3
Total...	2,259·4	1,459·03	902·0	68,106	47,596	25,095	4,514	3,110	1,747

SYSTEMS.

	Lines with overhead conductors. January 1st.			Lines with underground conductors.			Lines with middle rail.			Lines worked wholly by accumulators.			Lines on the mixed system (overhead wire and accumulators).			Total.		
	1898	1897	1886	1898	1897	1896	1898	1897	1896	1898	1897	1896	1898	1897	1896	1898	1897	1896
Germany	56	45	35	2	2	1	.	...	...	6	4		1	...	...	65	51	36
France	36	19	11	1	1	...	1	1	1	4	5	4	2	...	.	44	26	16
Great Britain ...	15	11	8	1	1	1	7	7	8	1	1	1	...	...	.	24	20	11
Switzerland ...	23	17	12		...	...	...	...	...	...	...	...	...	...	...	23	17	12
Italy	11	9	7	...	...	..	...	..	..	..	..	...	...	...	...	11	9	7
Austria-Hungary ...	11	7	6	2	2	1	...	...	..	1	1	2	...	...	...	13	10	9
Belgium	6	4	3	1	1	...	...	...	...	...	...	..	.	...	...	8	5	3
Spain	4	3	2	...	...	...	...	...	...	...	...	.	...	...	...	4	3	2
Russia	3	2	2	1	1	...	...	...	...		...	...	...	...	...	4	3	2
Sweden and Norway	3	1	1	...	...	...	..	...	...	..	..	...	...	...	...	3	1	1
Servia	1	1	1	...	...	...	...	...			...	...	...		...	1	1	1
Bosnia	1	1	1	..	...	..	...	...	...	..	...	...	...		...	1	1	1
Roumania	1	1	1	...	...	...	...	..	...	...	...	...	...	.	...	1	1	1
Holland	...	...	...	...	...		...	...	...	1	1	1	...	...	...	1	1	1
Portugal	1	1	1	...	...	...	...	..	..	...	...	...	...		.	1	1	1
Total ...	172	122	91	8	8	3	8	8	9	13	12	8	3	...	...	204	150	111

The First! The Best! The Last!—Hoult's original *electro-chemical* chimney and flue cleaner is a late discovery and invention for cleaning soot and scales out of stove pipes and ranges by a practical and scientific method. It more than does the work of a sweep, it requires but a few moments' time, it does its duty thoroughly, and all for *sixpence*. By burning an electro-chemical flue cleaner in a stove or furnace, it generates a gas *charged with electricity* that decomposes the soot, destroys all combustible matter, and causes it to pass out with the draught, leaving the pipe both free and clean. Here is a rare chance for an investigation by Lord Kelvin or Prof. J. J. Thomson into the electrification of electro-chemical stove pipe gases. "Mr. Hoult is indeed a very ingenious Yorkshireman," says the *Stationery World*. Just the sort of man, we would add, to keep the world, slowly as it moves, from absolute stagnation.

Appointment.—The Dewsbury Corporation has appointed Mr. O. M. Jonas, lately with Messrs. Ferranti, Limited, and the Newcastle Electric Supply Company, as borough electrical engineer at a salary of £250 per annum. There were 76 applications for the post.

The Nature of an Oath.—It is said that a well-known counsel, a familiar figure in electrical lawsuits, was examining a youth the other day, and asked him if he knew the nature of an oath. "Don't I just!" replied the boy with evident glee. "Was'nt I your caddie for three days when you wos playin' golf a few weeks ago; and then you arst me, Do I know the nature of an oath!"

The First Electric Automobile.—It is a fine thing for a modest man to have champions, and Mons. Raffard, the French engineer (whom we might fairly term "well known") finds his cause as inventor and designer ardently advocated by a friend in a journal called *Le Chauffeur*, a copy of which has just reached us. The article would appear to be written in defence of Mons. Raffard's title to the first practical designs for electric automotor vehicles actually carried out into operation on the road, and it recalls the original Faure accumulator patent of 1880 as a starting point. Some few months after this (in April, 1881, to be exact) Mons. Raffard made arrangements with the Paris Omnibus Company to take one of their vehicles for conversion to electric working, and at the same time completed an electric tricycle provided with 12 small Faure cells, the electric equipment weighing altogether about 160 lbs. The omnibus was completed, and ran on the streets in May and June, 1881, but was not shown at the Electrical Exhibition owing to an accident, which caused heavy repairs with a lawsuit to follow. This omnibus was one of the ordinary type, no alterations to the main structure or design being allowed, and was operated by means of a belt driving on to a differential pulley, which allowed for change of speed in either of the driving

wheels. The differential pulley was mounted on a countershaft connected to the driving wheels by chain gear, with pinions and toothed discs on the driving wheels. The advocate of Mons. Raffard's claim to be the first in the field with an electric automobile, considers that this vehicle (which ran either on the tram rails or the ordinary road surface at will) took precedence not only of the small electric railway at the Electric Exhibition of that year, but should also be regarded as the first practical result achieved for real working, although the Berlin Exhibition of 1880 had a small electric line in operation. Probably Mons. Raffard may claim with justice the first electric motor car for street work; certainly he did more than many others to advance the automobile, for in 1883 he had a tramcar running in Paris both on the rails and the road for 30 miles at a time. This vehicle weighed complete, in working order and fully loaded, about 11 tons. Not contented with claiming precedence for Mons. Raffard in regard to self-contained electric omnibuses, and even tramcars, the contributor to *Le Chauffeur* also tries to show that he must be considered the originator of heavy electric locomotives. Certainly he patented in France, towards the end of 1883, the details of an electric locomotive which compares very favourably with those now so well known in connection with the Baltimore Belt Line railroad. Not the least ingenious or interesting feature of the Raffard locomotive may be considered the method of elastic coupling together of driving wheels, with the driving discs mounted on the multipolar motor armature shaft. It is perhaps hardly correct to call the latter a "shaft," as it is hollow, like a sleeve, and surrounds the main driving axle. Whether or no Mons. Raffard was actually the first to design a workable electric omnibus, and also an electric locomotive for heavy working, the fact remains that he can claim credit for some very ingenious details that perhaps even yet have not come into the extensive use which their value and good points deserve.

The Efficiency of Transformers.—In a recent number of the *Elektrotechnische Rundschau*, Herr Schlatter, in an article on transformer distribution (which is condensed in the *Practical Engineer*), draws attention to the fact that, notwithstanding the very high efficiency of transformers at full load, they nevertheless show but a very low all-day efficiency when permanently connected across the mains, and states, as the result of experience of central stations, that the total energy delivered by a transformer during 24 hours is approximately equal to the energy it would deliver in one-twelfth of the time if worked at full load, and on this assumption he gives the all-day efficiencies, together with other data, of transformers of various capacities, which we append in the form of a table below:—

Output of transformer in kilowatts ...	1	2·5	5	10
Useful energy in kilowatt-hours ...	2	5	10	20
Iron losses in kilowatt-hours	1·56	2·28	3·72	5·52
Copper losses in kilowatt-hours ...	0·04	0·09	0·17	0·31
Meter losses in kilowatt-hours ...	0·288	0·288	0·576	0·864
Total energy absorbed, kilowatt-hours	3·888	7·658	14·466	26·694
All-day efficiency	0·515	0·625	0·692	0·75

To check the value of the assumption, equal numbers of the four types of transformers given in the table were connected across the mains from a large central station, when the mean all-day efficiency worked out at 0·652, or practically a mean of the efficiencies of the four types. With the object of increasing the all-day efficiency, the house transformer system has been abandoned in favour of the transformer sub-station system, with which the number of transformers may be greatly reduced, with a corresponding increase in their size and efficiency. The distinct economy of such a change has been shown by the results obtain in a town in Massachusetts, where 57 small transformers were replaced by 18 of a larger size. In this instance the total core loss of the small transformers, supplying about 1,500 lights, was 5,870 watts, whereas the 18 larger ones substituted supply 1,624 lights with a total core loss of only 1,348 watts. In order to reduce the losses as much as possible, it is necessary to keep only so many transformers in circuit as will enable them to work at full load, or nearly full load.

Some Recent Tests of Materials, &c.—*Technology Quarterly* publishes from time to time tests made in engineering laboratories, which are of some interest. In a recent number are given results of tests on bolted joints, some 14 in number, with a view to finding the efficiency. All the best specimens were made from plate of a tensile strength of 68,000 lbs., and bolts of machine steel of 96,300 lbs. tensile strength, the bolt holes being drilled and rimmed to take the turned bolts an easy driving fit. Two joints, which showed an efficiency of 65·2 per cent., were made with plates 14·64 inches wide and ·45 inch thick. There were three bolts pitched 4½ inches centres; they were 1¼ inches diameter. The net plate section was 4·90 square inches after rimming, and the tension on this section was 59,600 lbs. per square inch. The shear on the bolts was 39,700 lbs. per square inch. The compression on the plate was 173,100 per square inch, and failure was by tearing of the plate through the bolt holes. The bolts were damaged only. In the next tests, with plates 11·55 inches wide of a net area of 3·96, with two 1⅜ inches bolts pitched 5¾ inches. The plate tension was 49,000 lbs., the bolt shear 32,700 lbs., the plate compression 156,700, and the joint efficiency only 55 per cent., the joint failing by shearing of the bolts; yet the maximum shear was less than that which failed to shear the bolts of the last test. A repetition test showed almost the same figures. After the test the bolt holes were about half an inch longer than their width. In a one-bolt joint, with plates about 5½ inches wide and 1⅜ bolts, which sheared at a unit stress of 32,600 lbs., the joint efficiency was 59 per cent. and the plate tension 53,200 lbs. Generally these and previous tests seem to show that the strongest joints were those which failed through the plate; that when joints failed at the bolts by shearing, the unit shear was less than the stress, which did not shear the bolts when the plates failed; also, that when the plates failed, the strength of both plates and bolts was better developed than when the bolts failed. The lesson seems to be that generally there should be an excess on the side of the bolts. Generally, with bolts from ¾ inch to 1⅜ inches at pitches of 2 inches to 5¾ inches the joint efficiency only varied between limits of 57 and 65 per cent., the best results being with 1¼-inch bolts. All the plates were ·43 inches to ·45 inches thick, but the maximum plate tension per unit net area was greatest with the more numerous small bolts. Tests of wrought-iron pipe columns about ¼ inch thick and from 2 inches to 6 inches inside diameter showed, for the 2 inches to 4 inches columns, when from 6 feet to 10 feet in length, a crushing strength between 21,000 lbs. and 27,000 lbs. per square inch of cross-section, while for the columns 4 inches to 6 inches diameter the strength varied from 27,000 lbs. to 32,500 lbs. for lengths of 8 feet to 15 feet. The first lot of smaller columns merely had ordinary screwed-on cast-iron flanges; the second lot of larger size had the ends turned off square, and supported on cast-iron caps. Well made pipe columns may thus be rated at a crushing stress of, say, 25,000 lbs. per square inch, a useful figure to know, as wrought-iron columns of short length are often very convenient and useful, and easily made, from readily procurable materials.

American Society of Mechanical Engineers.—The above society holds its conference from Tuesday next, May 31st, to June 3rd, at Niagara Falls. The opening address will be delivered by Hon. Arthur Hastings, Mayor of Niagara Falls, and the work and methods of the Cataract Construction Company will be afterwards described by Messrs. Coleman Sellers and W. A. Brackenbridge. On the Wednesday the power works will be visited. There will be a number of papers read on mechanical engineering and allied subjects.

The Bastian Meter.—It has been suggested in some quarters that when reading the paper on electrolytic meters before the Institution, Mr. Gibbings did not give due credit to Mr. Bastian, the inventor of the meter. We happen to know that it was the express wish of the inventor that his name should not be mentioned, and it was in carrying out this request that omission of Mr. Bastian's name was made.

Electrically Operated Dredgers.—We described some time ago an electrically worked dredge which was being used in Spain, and was driven from a shore plant. In the minutes of *Proceedings of the Institution of Civil Engineers* a year or two back will be found a description of a dredge, electrically operated, and in use on a New Zealand river for gold recovery from the river bed, the rivers of Southern New Zealand being full of gold, which is only recoverable by dredging. In Colorado, where there are large deposits of auriferous gravels, dry dredgers and excavators have been brought into use by the Bennett Amalgamator Manufacturing Company. The dredger is what in England would be called an excavator. It is of the ordinary steam navvy type, with scoop bucket as used on canal and railway work. It is carried on a car body 40 feet long by 12 feet wide, built up of 20-inch rolled girders, and supported on two four-wheel diamond trucks. The amalgamator is carried at one end of the frame, and serves to balance wholly or in part the dredger boom. This boom is like the jib of a crane, and with its appurtenances will swivel round a central pillar, the swivelling power being a 5 H.P. General Electric Company's motor through bevel and spur gears. A 25 H.P. motor, with double reduction spur gear, actuates the dredging scoop and derrick motion. There is a third motor of 5 H.P. to move the dipper handle up or down in the main jib. Three motors perform every movement necessary. The amalgamator is driven by its own motor of 25 H.P., which also travels the whole machine on its rails and also drives the tailings elevator. Water to the amount of 1,600 gallons per minute is furnished by a fifth motor, and a 15 H.P. motor receives this water and discharges it, after it has done its work, to beyond the crest of the tailings pile. A 150 kw. dynamo supplies all the current, and may be placed anywhere convenient for either fuel or water power. The voltage is 500. The capacity of the dredge is great—200 yards per hour. The dipper swings twice a minute, and cuts a 60-feet circle to a depth of 8 feet below the rail level. Electro-magnetic brakes are provided to the three dredger motors, which have rheostat reversing controllers all mounted in the cab within reach of one man. The brakes are not strap brakes, but magnetic clutches arranged to draw a large disc against a stationary face with a releasing spring to push the disc back when the brakes are off. The pumps and amalgamator run constantly, and so only require rheostat starters. One man on the machine, with two men for track laying and in the pit are sufficient to handle the whole machine satisfactorily, apart, of course, from the attendance at the boiler house if steam power is the original source of power. The company build also river dredgers for gold recovery, self-contained, as necessary.

Cleaning the Globes of Enclosed Arc Lamps.—In an article in the *Electrical World*, Mr. J. H. Hallberg remarks that the trimming and cleaning of the inner globes on enclosed arc lamps is of the utmost importance, as the efficiency and candle-power depend, to a large extent, on the transparency of the inner globes. It will be found that most of them are covered inside with a grey-white dust, or film, which comes off if the globe is washed in clean water; but some, even after they are washed in water, show a brown-black stain around the top of the globe which apparently will not come off, no matter how much it is washed; in fact, it appears as though it were a natural colour in the glass itself. This is due to several causes. The most common is the impurity of the carbons, which contain too much metallic material; another is too great a length of the lower carbon, which brings the arc too near the neck of the inner globe; or the cause may be too much current flowing across the arc, especially during the few minutes after trimming the lamp with new carbons, this causing an excessive flame, that gets in contact with the globe, and in that way stains it. The only way to clean a globe in this condition is by dipping the burned part in hydrofluoric acid. This acid is very dangerous to handle, and much care should be exercised when it is used. As this acid will eat through almost every material except lead and wax, it must be kept in a jar of either of those materials. Mr. Hallberg prefers lead, as the acid gets warm when it acts on the glass, and he has seen cases where the wax melted and let the acid run out.

The War and the Cables.—It is stated in official circles at Madrid that the Spanish Government has decided, if the cable from Cuba is cut by Americans, to send some auxiliary vessels to cut all the cables landing in the United States territory.

The *Times* Washington correspondent says that it is proposed to close without delay the three remaining cable exits from Santiago de Cuba to Jamaica and Hayti, whence there is a choice of six routes to Spain. Little danger, it is thought, will attend the cutting of these cables, and no doubt is entertained as to the right of the United States to cut them, although most of them belong to British companies. General Greely, the chief signal officer, advanced the principle that the right existed to destroy cables in waters within Spain's jurisdiction. This principle has been accepted, and the Government are acting upon it.

The *Times* New York correspondent says that the censorship on cable despatches which now exists is of a somewhat crude form. Each company seems to be acting as its own censor, and the feeling is that the Government itself should assume responsibility instead of the company's clerks.

The following communication on the general question of submarine cables in war time appeared in Tuesday's *Times* from the pen of Prof. T. E. Holland, of Oxford:—

I venture to think that the question which has been raised as to the legitimacy of cable cutting is not so insoluble as most of the allusions to it might lead one to suppose. It is true that no light is thrown upon it by the Convention of 1884, which relates exclusively to time of peace, and was indeed signed by Lord Lyons, on behalf of Great Britain, only with an express reservation to that effect. Nor are we helped by the case to which attention was called in your columns some time since by Messrs. Eyre & Spottiswoode. Their allusion was doubtless to the "International" (L.R., 3 A and E., 321), which is irrelevant to the present inquiry. The question is a new one; but though covered by no precedent, I cannot doubt that it is covered by certain well-established principles of international law, which, it is hardly necessary to remark, is no cut-and-dried system, but a body of rules founded upon, and moving with, the public opinion of nations.

That branch of international law which deals with the relations of neutrals and belligerents is, of course, a compromise between what Grotius calls the *belli rigor* and the *commerciorum libertas*. The terms of the compromise, originally suggested partly by equity partly by national interest, have been varied and re-defined, from time to time, with reference to the same considerations. It is perhaps reasonable that, in settling these terms, preponderant weight should have been given to the requirements of belligerents, engaged possibly in a life and death struggle. "*Jus commerciorum æquum est*," says Gentili; "*at hoc æquius, tuendæ salutis.*" There is accordingly no doubt that in land warfare a belligerent may not only interrupt communications by road, railway, post, or telegraph without giving any ground of complaint to neutrals who may be thereby inconvenienced, but may also lay hands on such neutral property—shipping, railway carriages, or telegraphic plant—as may be essential to the conduct of his operations, making use of and even destroying it, subject only to a duty to compensate the owners. This he does in pursuance of the well-known *droit d'angarie*, an extreme application of which occurred in 1671, when certain British colliers were sunk in the Seine by the Prussians in order to prevent the passage of French gunboats up the river. Count Bismarck undertook that the owners of the ships should be indemnified, and Lord Granville did not press for anything further. Such action, if it took place outside of belligerent territory, would not be tolerated for a moment.

The application of these principles to the case of submarine cables would appear to be, to a certain point at any rate, perfectly clear. Telegraphic communication with the outside world may well be as important to a State engaged in warfare as similar means of communication between one point and another within its own territory. Just as an invader would, without scruple, interrupt messages, and even destroy telegraphic plant, on land, so may he thus act within the enemy's territorial waters, or, perhaps, even so far from shore as he could reasonably place a blockading squadron. It may be objected that a belligerent has no right to prevent the access of neutral ships to unblockaded portions of the enemy's coast on the ground that by carrying diplomatic agents or despatches they are keeping up the communications of his enemy with neutral Governments. But this indulgence rests on the presumption that such official communications are "innocent," a presumption obviously inapplicable to telegraphic messages indiscriminately received in the course of business. It would seem, therefore, to be as reasonable as it is in accordance with analogy that a belligerent should be allowed, within the territorial waters of his enemy, to cut a cable, even though it may be neutral property, of which the *terminus ad quem* is enemy territory, subject only to a liability to indemnify the neutral owners.

The cutting, elsewhere than in the enemy's waters, of a cable connecting enemy with neutral territory, receives no countenance from international law. Still less permissible would be the cutting of a cable connecting two neutral ports, although messages may pass through it which, by previous and subsequent stages of transmission, may be useful to the enemy.

A brief note appeared in yesterday's *Times*, from Messrs. Eyre & Spottiswoode, in reply to the above.

A *Daily Chronicle* despatch, dated New York, Tuesday, says that "shortly after midnight much excitement was

caused here by the discovery that the Western Union Telegraph and Telephone wires to Sandy Hook were interrupted. These wires connect the harbour fortifications and city. It is supposed that the interruption was effected by Spanish agents. The Postal Telegraph Company's wire is still working."

According to the *Financial News*, the New York *Sun* has received news from St. Thomas showing that the recent bombardments of Santiago de Cuba and Guantanamo arose from some cable-cutting exploits by the United States cruiser *St. Louis* and the gunboat *Wampatuck*. The *St. Louis*, while picking up a cable off Santiago, came within range of the Morro Fort there, and instantly became a target for its guns. The cable was severed, and the vessels left for Guantanamo, where similar incidents took place. They silenced the shore batteries and cut the cable.

Municipal Electrical Association Meeting. — The programme of the third annual convention of this association is to be held at the Royal United Service Institution, Whitehall, S.W., on June 8th, 9th, 10th, and 11th. The president of the year is Mr. A. H. Gibbings; the vice-presidents being Messrs. Faraday Proctor, and Wilmshurst. The presidential address will be delivered on Wednesday morning, and the papers down for discussion are as follow:—

"The Management of Electrical Undertakings," by Councillor Hesford, Southport Electricity Committee.
"Switchboard Apparatus," by J. R. Blaikie, Chief Assistant Electrical Engineer, Bristol.
"Steam-using Plant," by J. A. Jeckell, Borough Electrical Engineer, South Shields.

Visits will be paid to the Waterloo and City Railway, and to the Islington Electricity Works; and in the evening the Association Dinner will take place at the Holborn Restaurant. On Thursday papers will be discussed as follow:—

"Uniformity of Plant," by C. H. Wordingham, Manchester.
"Appropriation of Profits and Repayment of Loans," by Bailie W. Maclay, convener of the Glasgow Electricity Committee.
"Single *v.* Multiple Generating Stations," by J. F. C. Snell, Sunderland Borough Electrical Engineer.

Visits will be paid to the works of Messrs. Willans & Robinson, Limited, at Rugby, Croydon electricity works, and the General Electric Company's lamp works. On the Friday papers are to be discussed as follow:—

"Electric Traction," by R. C. Quin, Blackpool borough electrical engineer, and J. E. Stewart, Derby borough electrical engineer.
"Accumulators in Connection with Lighting and Traction," by J. H. Rider, Plymouth borough electrical engineer.
"Stand-by Supply," by R. C. Quin, Blackpool.

Visits will be paid to Messrs. Siemens Bros. & Co.'s works at Woolwich, and the Shoreditch electricity works. The business meeting will be held on Saturday, June 11th, and in the afternoon visits will be paid to the Portsmouth and Dover electricity works.

Death by Electricity.—Our New York namesake, having reprinted from our columns Dr. Hedley's recent article on "Death by Electricity," Dr. J. Mount Bleyer writes to that journal criticising the article, saying:—

I carefully looked over the article, and must say that I failed to learn therefrom anything original, either from investigations or suggestions on the part of the author. The whole matter contains nothing but a rehash of what others have done. I therefore cannot find a single peg or plea—to hang it upon—for his having written this article except for reviewing some of the already known works of others. As father and one of the first experimenters on electrocution, a few words in answer to this review will be acceptable to your readers, &c., &c.

As a matter of fact, Dr. Hedley's article was what it was intended to be—a judicial summary of all that is worth knowing on the subject of death by electricity. It was not written to proclaim his own praises, nor to claim anything for himself—not even the title of "Father of Electrocution," or foster-father of the high-sounding phrase "dynamic apoplexy" (a term used by Dr. Bleyer in his letter), which, in the present connection, means about as much as Mesopotamia.

The New German Cable.—We understand two officials of the German Government have arrived in London to discuss the question of the proposed new German cable from the Azores across the Atlantic.

Copper.—The *Engineer* asks, "Is there to be a copper famine?" In the reply to this question, says our contemporary, the boilermaking and general engineering trades are vitally interested. And certainly the way in which the copper market has been jumping lately makes such a query not at all unreasonable. During last year this metal has been higher than the year before by an average of £2 per ton, and this advance has recently been greatly accentuated by the war. The production and consumption of copper was on a greater scale in 1897 than in any previous year in the history of the trade, no less than 396,723 tons having been produced, against 373,368 tons in 1896. Yet notwithstanding this great increase of 23,000 tons, the present visible supply in this latter part of May is at least 5,000 tons less than it was 12 months ago. The general increase in the consumption of copper for electrical engineering services and for marine engineering purposes is chiefly responsible for this diminution. European consumers are depending to a greater extent than ever before upon American supplies. The trans-Atlantic production has been, and still continues to be, on a very large scale. The price of copper to-day is altogether out of proportion to the quantity available for use, it being £2 per ton cheaper than at the same date in 1891, although the visible supply—or quantity in stock—is less than half what it was in 1891. In fact, the present stock is only sufficient for five weeks' consumption, and if the war between the United States and Spain is prolonged—for they, of course, are the two chief producing countries—there is no knowing to what extent the supply may be diminished; so that a copper famine is quite within the bounds of possibility, and those who have much to do with this useful metal in any capacity will act wisely if they regulate their operations in accordance with that possibility. Any real scarcity would, however, be only temporary, for new sources of supply are not infrequent—the latest copper discovery being just announced from Russia, where extensive copper ore beds have been found at Potar, only 10 miles from a point on the Samarkand-Andidshan railway.

Obituary.—The death is announced of Mr. R. Stuart Hampson, of Mayfield, Withington, at the early age of 37 years. At the time of his death Mr. Hampson was the electrical engineer of the Great Central Railway Company, and also of the Manchester and South Junction Railway. He joined the service of the Great Central about 11 years ago as telegraph engineer and superintendent, and since then he has carried out many important engineering works. Previously, as an assistant of the late Mr. E. C. Warburton, telegraph superintendent of the Lancashire and Yorkshire Railway Company, Mr. Hampson erected the electric light installation—one of the first in the country—at the grain silo at Fleetwood, in the early eighties. Mr. Hampson was a member of the Institution of Electrical Engineers, and was president of the Association of Railway Telegraph Engineers and Superintendents of Great Britain for the years 1896-7-8. He was a frequent contributor to scientific and electrical journals, and his professional advice was frequently sought.

Personal.—We are glad to be able to inform the many friends of Mr. H. Hirst, of the General Electric Company, of London, that he is now recovering from the serious operation which was quite successfully performed on Tuesday last.

Queensland Electrical Association.—On the initiative of Mr. John Hesketh, the Government electrical engineer, an electrical association is being formed for Queensland. The association would have for its objects the promotion of the general advancement of electrical and telegraphic science and its applications, the facilitating of the exchange of information and ideas on these subjects amongst its members and the general public, and would hold meetings, publish papers, &c. The *British Australasian* says that at a recent meeting at Brisbane a committee was formed for the purpose of drafting rules for the approval of a subsequent meeting. The committee consists of Messrs. J. S. Badger, E. G. Barton, C. H. Caspersonn, J. H. Durant, and J. Hesketh. Mr. J. Power, Post and Telegraph Department, Brisbane, is secretary to the committee.

Röntgen Rays in Warfare.—Before the Royal United Service Institution on Friday last, Surgeon-Major Beevor, M.B., Army Medical Staff, lectured on the "Working of the Röntgen Ray in Warfare." The lecturer said, according to the *Times* report, that his object was to give his experience in the working of the X ray in military surgery, and through the kindness of many official friends he would be able to give the audience the results of its employment on the recent frontier expedition in India, and then to lay before them some modifications in the construction of the appliances for generating the X ray which had suggested themselves to him after working among the wounded on the field of battle and its adjacent hospitals. He then exhibited, by means of the magic lantern, photographs of cases from the Frontier War, which showed with the utmost clearness the importance of the use of the X ray in the treatment of wounded men. The positions of bullets in various parts of the body were made perfectly evident in cases where it was quite impossible to localise the bullets by ordinary surgical methods. The lecturer said that it was not only possible, but quite easy to have an X ray apparatus working at the front. The cases exhibited contained indisputable proof that even in savage warfare, where the Geneva Convention was unknown, the X ray could be brought under control, and an immensity of human suffering obviated; it was not necessary that every field hospital or bearer company should be supplied with an apparatus, as it could be readily transported from one part to another of the field of operations. He felt sure they would see what an advantage it was to be able to localise bullets, and other foreign bodies, without the painful process of searching with probes, and that a threefold advantage was gained in the treatment of patients by this means—first, the absence of any pain or physical injury, from which arose the second advantage, that in cases where there had been much loss of blood or injury to bone, they were enabled to ascertain the exact condition of affairs, without the risk of increasing the depression of the patient by operation, and they thus gave him the best chance of reaction, upon which depended his recovery. He maintained that it was now the duty of every civilised nation to supply its wounded in war with an X ray apparatus, among other surgical aids, not only at base hospitals, but close at hand, wherever they might be fighting and exposing themselves to injury in the performance of their hazardous duty. The rest of the lecture was devoted to the consideration of technical questions in connection with the appliances required for generating the X ray.

Electric Light Wires as Telephonic Circuits.—In a letter to *Nature*, Mr. F. J. Jervis-Smith, of Oxford, describes a method of using electric lighting wires as telephonic circuits. He was requested some time ago to try to localise a fault in an electric light main, by means of a certain form of inductor used in conjunction with a telephone but not connected to the main. While using it, it occurred to him that probably the main might be used instead of a telephone wire. His first experiments were not productive of good results, as a small fraction of the company's current passed continuously through the telephone. In October, 1897, he placed $\frac{1}{3}$ microfarad condensers in his telephone circuit at each end; these stopped the current, but in no way reduced the telephonic effects. If the note given out by virtue of the rotation of the armature of the dynamo is great, it can be very greatly reduced by placing an inductively-wound resistance in the circuit. The resistance, he writes, does not appear to modify the telephonic effects in any marked degree. This probably arises from the fact that the E.M.F. due to the secondary coil of the telephone transmitter is high. The experiment was successfully made over two miles of a main which was carrying the full load used in lighting the town.

The Royal Society.—The following were among the papers down for reading yesterday afternoon:—Prof. Roberts-Austen, F.R.S., "On Surfusion in Metals and Alloys." Dr. J. Larmor, F.R.S., "Note on the Complete Scheme of Electro-dynamic Equations of a Moving Material Medium, and on Electrostriction." E. Wilson, "Aluminium as an Electrode in Cells for Direct and Alternate Currents." Dr. Capstick, "On the Kathode Fall in Gases."

Fatal Shock Accident at Chelmsford.—On Saturday, 21st inst., Edward Fell, the outdoor foreman of the Chelmsford Electric Lighting Company, went to a small transformer pit to switch off the transformer with a view to removing some secondary leads. He switched off the transformer, and afterwards, whilst removing some high pressure leads with his ungloved left hand, touched another high pressure lead with his right hand, and was immediately killed. The inquest was opened on Monday, 23rd inst., but was adjourned until yesterday (Thursday). Major Cardew held an official inquiry into the matter on Tuesday.

Erratum.—In the evidence given before the Select Telephone Committee, on page 722 of this issue, *Mr. F. T. Lamb* should, of course, read as Mr. J. C. Lamb, C.B.

NEW COMPANIES REGISTERED.

Cowans, Limited (57,378).—Registered May 16th, with capital £30,000 in £5 shares (2,000 7½ per cent. cumulative preference), to carry on the business of electricians, suppliers of electricity, mechanical and general engineers, contractors, machinists, &c. The subscribers (with one share each) are:—T. S. Cowan, 4, Marlborough Road, Ealing, solicitor; C. C. Smith, Bengeo, Hertford, gentleman; A. E. Hale, 18, Austin Friars, E.C., clerk; H. J. Wells, 5, Victoria Grove, Stoke Newington, clerk; E. W. Cowan, Hart Hill, Bowden, Cheshire, civil engineer; E. J. Cowan, 26, Kenilworth Road, Ealing, gentleman; A. J. Wells, 5, Victoria Grove, Stoke Newington, clerk. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £50 each per annum. Registered by E. W. Cowan, Hart Hill, Bowden, Cheshire.

Leyland and Birmingham Rubber Company, Ltd. (57,410).—Registered May 18th, with capital £300,000 in £1 shares, to adopt agreements (1) with the Leyland Rubber Company, Ltd.; (2) W. Stanley Morrison & Company, Limited; and (3) with "The Birmingham India-Rubber Company," and to carry on the business of manufacturers and dealers in India-rubber, gutta-percha, flax-hose, flax and cotton belting, &c., electricians, telegraph and electrical engineers and contractors, cable and telegraph instrument manufacturers, pneumatic and other tyre manufacturers, cycle manufacturers and dealers, motor car builders, engineers, machinists, &c. The subscribers (with one share each) are:—J. E. Baxter, Highfield, Leyland, Lancashire, manufacturer; J. W. Brown, Beech Mount, Bolton, cotton waste dealer; S. Whitehead, Sunnyside, Leyland, manager; J. W. Kenyon, The Hollies, Bury, gentlemen; J. A. Fallows, 14, New Brown Street, Manchester, salesman; E. T. Everett, 3, Stevenson Square, Manchester, merchant; R. T. Byrne, 124, New Street, Birmingham, manufacturer. The number of directors is not to be less than three nor more than seven; the first are: J. E. Baxter, A. S. Morrison, R. T. Byrne, J. W. Brown, and S. Whitehead; qualification, £2,500; remuneration, £52 10s. each per annum. Registered by Jordan & Sons, Limited, 120, Chancery Lane, W.C. Registered office, Golden Hill Works, Leyland, Lancashire.

The Caledonian Wire Rope Company, Limited (3,875).—Registered at Edinburgh, May 17th, with capital £20,000 in £10 shares, to carry on in the United Kingdom or abroad the business of manufacturers of wire ropes, electric cables, telegraph wires and lightning conductors and wire fencing of every description. The subscribers (with one share each) are:—J. Wilson, Airdrie House, Airdrie, M.P.; R. Moore, 156, St. Vincent Street, Glasgow, C.C.; R. Wilson, 75, Bothwell Street, Glasgow, coal master; J. Dixon, 127, St. Vincent Street, Glasgow, coal master; J. Mitchell, Airdrie, banker; W. Hugh, Thornhill, Blantyre, wire rope maker; J. Hugh, Thornhill, Blantyre, wire rope maker. The first directors are J. Wilson, R. Wilson, J. Mitchell, W. Hugh and J. Hugh. Qualification, £100. Registered by Oswald & Son, Edinburgh.

Werner Cadmium Electric Accumulator Syndicate, Limited (57,417).—Registered May 19th, with capital £6,000 in £1 shares, (2,250 preference), to adopt an agreement with Alexis Werner, and to carry on the business of an electric accumulator and electric supply company, also electricians, mechanical engineers, and electrical apparatus manufacturers. The subscribers (with one share each) are:—H. Simmons, 5, Sydenham Park, S.E., engineer; R. S. Keary, 1, Lea Hall Road, Leyton, E., clerk; T. L. W. Ginger, 39, Roseman Road, S.W., traveller; L. Sternberg, 22, Little Alie Street, Aldgate, E., clerk; G. Goodman, 21, St. Helen's Place, E.C., solicitor; M. Goodman, 21, St. Helen's Place, E.C., clerk; W. G. Richardson, 88, Dempsey Street, Stepney, clerk. Registered without articles of association. Registered office, Devonshire Chambers, Bishopsgate Street Without, E.C.

Electric Theatre, Limited (57,446).—Registered May 20th, with capital £5,000 in £1 shares, to erect, produce, construct, organise, exploit and show an electric theatre or music hall, and to carry on the business of electricians, mechanical engineers, suppliers of electricity, &c. The subscribers (with one share each) are:—J. H. Harrison, 31, Bow Street, W.C., costumier; A. J. Thomas, 30, Regent Street, S.W., gentleman; S. Jousiffe, Grosvenor House,

Kensington Park, wine merchant; J. L. Camp, 1, Spridgdale Road, Stoke Newington, artist; A. R. Kelly, 5, Camden Square, N.W., surveyor; E. Tremearne, 34, Gresham Street, E.C., accountant; M. W. Taylor, 34 and 36, Gresham Street, E.C., solicitor. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration as fixed by the company. Registered by Stanley & Co., 45, Ludgate Hill, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Barcelona Tramways Company, Limited (6,544)—This company's return was filed on March 24th, when 23,000 shares were taken up and paid for in full out of a capital of £300,000 in £10 shares.

Anglo-Portuguese Telephone Company, Limited (24,545).—This company's return was filed on April 15th, when 50,000 shares were taken up out of a capital of £75,000 in £1 shares, all of which are considered as fully paid.

Edmondson Electricity Meter Syndicate, Limited (41,756).—This company's annual return was filed on April 26th, when 175 shares were taken up out of a capital of £2,000 in £1 shares; 168 are considered as paid, and £7 has been received.

Eastbourne Electric Light Company, Limited (16,422).—This company's annual return was filed on May 3rd, when 1,949 shares were taken up out of a capital of £50,000 in £10 shares, and paid for in full.

Edison-Gower Bell Telephone Company, Limited (16,010).—This company's return was filed on April 15th, when 385,009 shares were taken up out of a capital of £500,000 in £1 shares. 370,000 have been considered as paid, £15,005 has been received, and £4 is in arrears.

CITY NOTES.

The Worcester Accounts.

The result of the year's working is that the gross profit amounts to £2,195, the net deficiency, after setting aside amounts for sinking fund, being £1,474. The works' costs are slightly higher than those of last year, and the reasons given by Mr. Ruthven Murray in his very excellent report to the municipality are as follow:—

"The greater consumption of fuel during last year is mainly responsible for the higher works' cost, and it at first sight appears paradoxical that while so many more units were generated by water-power, the coal account should have increased. The following is the explanation:—By reason of an increased private day load and public lighting load, extending daily over many hours, it was possible to use more water-power when the supply was plentiful, but it necessitated more steaming on low loads when the limits of the water-power were exceeded, or when no water could be obtained. During the fall of year, when the flow of water was exceptionally small, the percentage of steaming hours and steam generated units became very high. Owing to the engineers' strike and the stoppage of work, we were unable to get any of the extension plant which was ordered last year. The day load engine, which was more than ever required, has only just been delivered. Consequent upon the increase of the mean load, and the small flow of water, the steaming hours increased from the previous year's 33 per cent. to 45 per cent. of the total, and the cost of coal, per sold steam unit generated, from 1·06d. to 1·32d. With the new small engine at work, I look forward with confidence to a reduction in this figure for the present year.

"As the works have been taken to the water, fuel has also to follow, and at a moderate estimate the extra cost for increased railway dues and cartage on the 1,702 tons of coal used was £127, which should, of course, be deducted from the revenue derived from the water-power. It may also be noted that the above sum represents 6 per cent. on £2,100."

The following table gives the cost per unit:—

	1897.	1896.
Total capital expended	£67,293	£60,718
Number of units sold	429,270	333,644
Number of lamps connected	—	—
Revenue from sale of current	£5,948	—
Net revenue	£2,195	—
Average price obtained per unit ...	3·14d.	—

Cost of Production.	£	Per unit.	1896.
Coal	1,328	·74d.	—
Oil, waste, water, and engine room stores	144	·08d.	—
Salaries and wages at generating station	1,176	·66d.*	—
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	744	(Works' cost) 1·90d. ·42d.*	—
Rent, rates and taxes	87	·05d.	—
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges and insurance	485	·27d.	—
Depreciation of buildings and plant account	—	—	—
Renewal fund account	—	—	—
Total	£3,964	2·22d.	—

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	5,948	0	0	3·14d.
Meter rents, &c.	192	0	0	—
Supply of steam	—			—
Transfer fees	—			—
Other items	151	0	0	—
Total	£6,291	0	0	3·14d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·22d.; works' cost, 1·90d.

* Including charges for public lamps.

The Shoreditch Electric Lighting Accounts.

The lighting accounts of the Shoreditch Vestry for the nine months ending March 25th, while presenting some interesting features, are nevertheless incomplete, because they do not include any statement setting forth the financial results of the dust destructor. Though dust destruction and electric lighting go hand in hand in the parish of Shoreditch, we understand that it is impossible to do otherwise than present separate accounts. Before an extended criticism were offered it would be necessary to have complete figures relating to both departments of the undertaking, and we shall therefore wait until the publication of the dust destructor accounts.

The form of the accounts is by no means a model of perspicuity, and it is to be regretted that the Board of Trade form is not adhered to. The net result of the undertaking is, that after providing for redemption of capital and payment of interest, there is a profit of £2,072. Of this sum £1,255 goes to pay off previous calls on the rates, which leaves a round sum of £700 to be carried forward. No provision has been made for depreciation. The least satisfactory feature in the report is the statement relating to electricity generated, and we reproduce the table as it stands:—

Statement of Electricity Generated, Sold, &c.

Quantity generated in B.T. units.	Quantity sold.				Quantity used on works.	Total quantity accounted for.	Quantity not accounted for.	Number of public lamps.	Total maximum supply demanded.
	Public lamps.	By contract.	Private consumers by meter.	Total sold.					
491,107	80,791	...	203,504	284,295	156,725 including that quantity used by lift and fan motors, also loss in distribution.	441,020	50,087	57 arcs, 114 incandescents (32 C.P.)	408 kw.

If we add to the amount of electricity used in works and lost in distribution, the quantity unaccounted for, we arrive at 206,812 units, which is not far off half the total quantity generated, and is in excess of the total current sold to private consumers.

An analysis of the cost of production shows the following:—

	1897.	1896.
Total capital expended	£87,802	—
Number of units sold	284,295	—
Number of lamps connected ...	—	—
Revenue from sale of current ...	£6,118	—
Net revenue	£3,730	—
Average price obtained per unit ...	5·14d.	—

Cost of Production.	£	Per unit.	1896.
Coal	279	·23d.	—
Oil, waste, water, and engine room stores	226	·19d.	—
Salaries and wages at generating station	774	·65d.	—
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	276 (Works' cost 1·30d.)	·23d.	—
Rent, rates and taxes	19	·02d.	—
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	412	·35d.	—
Depreciation of buildings and plant account	—	—	—
Renewal fund account	—	—	—
Total	£1 9·6	1·67d.	—

Revenue.	£ s. d.	Average price obtained per unit.
By sale of current	6,118 0 0	5·14d.
Meter rents, &c.	—	—
Supply of steam	—	—
Transfer fees	—	—
Other items	3,643 0 0	—
Total	£9,761 0 0	5·14d.

Total cost per unit (exclusive of depreciation and renewal accounts), 1·67d.; works' cost, 1·30d.

The Electric Railway and Tramway Carriage Works, Limited.

The prospectus of this company has been before the public this week: the list of subscriptions closing on Wednesday. The nominal capital is £150,000 in £5 shares, and the present is an issue of 22,000 shares, of which the vendors, who are the promoters of the company, have agreed to take 3,000 in part payment of the purchase money. The company has been formed to manufacture all classes of cars and railway carriages, but especially tramway cars for horse, electric, and cable roads, and vehicles for light railways. The production of electric motor trucks and steel underframes for Indian and Colonial railways, will also be a feature of the undertaking. The company has also been formed to acquire valuable property and works in West Strand Road, Preston, Lancashire, having an area of nearly 12½ acres, about 9½ acres, of which will be used by the company for the above purposes.

The present is considered the right moment to bring out the company, in view of the extensive movement all over the country in the adoption of mechanical traction.

The vendors will furnish and equip the works with machinery of the most modern character, and lay down plant for driving the principal machinery by electric motors. They will also construct an overhead electric tramway system through the works and grounds, so that all cars manufactured can be properly tested before leaving the works.

It does not appear that the company is to acquire any business reputation or connection, or to take over any orders, but it is expected that the works, *when completed*, will be capable of an output of 600 cars per annum at least, although, as we presume the works cannot get into full working order for some little time, profits may have to be waited for. The company will sell cars and other rolling stock on the hire-purchase system as required.

Mr. Wm. Wilson has reported upon the value of the works and property, and *when completed* they will, in his estimation, work out at £59,465. Mr. Stephen Sellon has reported upon the contract for the equipment of the works, and both his and Mr. Wilson's statements are included in the prospectus.

The vendors are to receive £80,000, payable as to £65,000 in cash and £15,000 in fully paid shares, leaving £30,000 available for working capital. The directors are: George Richardson, Esq., chairman North Metropolitan Tramways Company, chairman; George F. Fry, Esq., J.P., director Brisbane Electric Tramways Company, Limited; Richard H. Prestwich, Esq., deputy-chairman Blackpool and Fleetwood Tramroad Company; John Kerr, Esq., director Edinburgh and District Tramways Company, Limited; George Flett, Esq., director Newcastle and Gosforth Tramways Company, Limited. The secretary (*pro. tem.*) is Mr. Frederick Crimes, 13, Spring Gardens, Manchester.

The West African Telegraph Company, Limited.

The report and accounts of the directors for the year ended December 31st, 1897, presented to the thirteenth ordinary general meeting, held at Winchester House, 50, Old Broad Street, London, E.C., yesterday, states that the company's revenue for that period amounted to £64,722 15s. 2d., against which £21,212 9s. 2d. is charged for ordinary expenses, and £18,780 4s. 4d. for expenditure relating to repairs of cables, &c. After providing £860 2s. 3d. for income-tax, and £225 1s. 3d for re-valuation of currency assets, there remains a balance of £23,644 18s. 2d, to which is added £459 10s. brought from the preceding year, making a total available balance of £24,104 8s. 2d. From this balance there has been deducted £10,098 9s. for interest on debentures, and £13,633 6s. 8d. for sinking fund, leaving a balance of £372 12s. 6d., which it is proposed to carry forward to next year. The director who retires by rotation is Robert Kaye Gray, Esq., who, being eligible, offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, and offer themselves for re-election.

The Marquis of Tweeddale presided at the ordinary meeting of the company.

The Chairman said the gross revenue for 1897 was £64,723, a decrease of £6,266 compared with 1896; this was accounted for by the falling off in the Cape joint-purse traffic, which amounted to £1,693, the increased loss in exchange of £2,699, which could not possibly have been foreseen, and to increase under the head of rent of cable, £1,074. The last increase was explained by the interruption of cable between Bathurst and St. Vincent, which occurred simultaneously with interruption to communication by the East Coast, compelling them to divert traffic on to lines not belonging to the company, and for which they had to pay rent. The total working expenses for the year amounted to £21,212, or an increase of £3,314. Repairs of cables was £18,780, or a decrease of £1,915. Although this was a decrease, the figures were still exceptionally high. The French Government still continued to withhold subsidies, the action of the Government being due to difference of opinion, based on certain clauses of their concession. They were anxious to maintain good relations with the French Government, and they submitted a proposal for the settlement of the differences, conceived in a very liberal spirit, and they had reason to think it was acceptable. It had not yet received the confirmation of the Chamber, which was probably accounted for by the election nearly concluded. They hoped before long to come to an arrangement satisfactory to all parties.

The report and accounts were then adopted. Mr. Robert K. Gray, the retiring director, and the auditors, were then re-elected.

British Aluminium Company, Limited.—This company has, during the past week, been inviting applications for an issue of £100,000 5 per cent. debentures, of which £18,000 has already been applied for and allotted to shareholders. The list closed on Wednesday, 25th inst. The money is required to provide for a larger output at the different factories, the necessary additional works being now in course of construction.

Brazilian Submarine Telegraph Company, Limited.—The directors have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income-tax, for the quarter ended March 31st, 1898, and payable on June 24th. The transfer books of this company will be closed from June 17th to the 23rd, both days inclusive.

Detroit Telephone Company.—The directors have declared a quarterly dividend of 2 per cent., being at the rate of 8 per cent. per annum, payable on and after 16th inst., to all holders on the register on April 30th.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending May 20th, 1898, were £2,696 13s. 9d.; corresponding period 1897, £2,483 19s. 1d.; increase, £212 14s. 8d.

The City and South London Railway Company.—The receipts for the week ending May 22nd, 1898, were £987; week ending May 23rd, 1897, £958; increase, £29; total receipts for half-year, 1898, £21,666; corresponding period, 1897, £21,461; increase, £205.

The Dover Corporation Electric Tramways.—The receipts for the week ending May 14th, 1898, £135 5s. 11d.; total receipts to May 14th, 1898, £2,217 8s. 7d. Week ending May 21st, 1898, £127 16s. 5d.; total receipts to May, 1898, £2,209 19s. 1d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for week ending Friday, May 20th, 1898, were £563 3s. 4d.; corresponding week last year, £609 17s. 10d.; decrease, £106 14s. 6d.; passengers carried, 88,163; corresponding week last year, 95,616; aggregate to date, £8,921 1s. 1d; aggregate to date last year, £9,367 15s. 9d.; decrease to date, £446 14s. 8d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending May 22nd, 1898, amounted to £1,416; corresponding week last year, £1,386; increase, £30.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending May 20th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,259.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, May 18th.	Closing Quotation, May 25th.	Business done during week ended May 25th, 1898. Highest.	Lowest.
137,400£	African Direct Telegraph, 4 % Deb.	100	4 %	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	7 — 8	7 — 8	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	93 — 96	93 — 96	...	...
923,960£	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	63 — 66	64 — 67	64	63
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	112½—113½	114 —115	114½	113
3,038,020£	Do. do. Deferred...	Stock	...	...	...	14⅜— 15¼	15¼— 15¾	15⅝	14⅛
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15¼— 15¾	15¼— 15⅜	15⅝	15½
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	112 —116	112 —116	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	175 —185	170 —185	...	...
918,297£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	104¼
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½%	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	7 — 8	6½— 7½	7	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14½— 15½	14½— 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	103 —106%	103 —106%	...	...
60,710£	Direct United States Cable	20	2¼ %	2½ %	...	10¼— 10¾	10¼— 10¾	10 9/16	10½
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½%	6½ %	...	16¾— 17¼	16¾— 17¼	17 1/16	16 15/16
70,000	Do. 6 % Cum. Pref.	10	6	6 %	...	18 — 19	17½— 18½	18	17¾
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	100 —103	100 —103	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	123 —127	123 —127	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17½ — 18	17½ — 18	17¾	17½
25,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	100 —104	...	...
100,500£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	127 —130	126 —129	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	101 —104	101 —104	102¼	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	105 —108	105 —108%	105	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	4½%	11¼— 11¾	11½— 12	11⅞	11¼
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16½— 17	16¾— 17¼	16 13/16	16½
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	28 — 29	28½— 29½	28 9/16	28½
160,000£	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	100 —103	100 —103	...	...
97,000	Halifax and Bermuda Cable, 4½ % 1st. Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	97 —102	97 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	50 — 53	50 — 53	52	50⅛
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	107 —110	107 —110	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000 ...	5	4 %	4 %	4 %	2 — 2¼	2¼— 2¾	...	...
484,597	National Telephone, 1 to 484,597	5	5¼%	5¼%	6 %	5⅝— 5⅞	5½— 5¾	5¾	5⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	14 — 16	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5⅝	5 9/16
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —104	99 —104	102½	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	¾	11/16
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9	8 — 9	8 11/16	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Telephone	5	4 %	5 %	...	4 — 4½	4 — 4½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	105 —108	104 —107	...	...
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	*nil*	*nil*	3½— 4½	3½— 4½	...	...
213,400£	Do. do. 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3¼%	11¾— 12¼	11½— 12	...	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7½— 8	7½— 8	7⅞	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	½%	4 — 4½	4 — 4½	...	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	105 —108	104 —107	106½	...
88,321	West India and Panama Telegraph	10	⅞%	1 %	¾%	½— ¾	½— ¾	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	7¼— 7⅝	7¼— 7⅝	7 11/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	105 —108	105 —108	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	103 —108	103 —108	...	...
160,100£	Do. do. do. 6 % Ster. Bonds ...	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	13 — 14	12 — 13	12¾	12 9/16
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277... ...	5	5 %	5 %	6 %	9 — 10	8½— 9½	9⅛	8⅝
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½%	4½%	4½%	115 —117	115 —117	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	23½— 24½	24½— 25½	25⅛	23½
10,000	Do. Prov. Certs. Nos. 90,001 to 100,000 £5 ...	10	...	...	...	16 — 17	16½— 17½	16⅜	16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17½	16½— 17½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 —134	129 — 134	...	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	12 — 13	13 — 14	13¾	12½
10,000	Do. do. do. Nos. 30,001 to 40,000 £4 paid.	10	...	...	...	6 — 7	6½— 7½	7	6 1/16
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	15 — 16	15 — 16	15	14¾
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400 £4 paid	5	...	...	...	3½— 4½	3½— 4½	4½	...
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	9 — 10	9 — 10	...	...
10,000	Do. do. 7 % Cum. Pref....	5	7 %	7 %	7 %	11 — 12	11 — 12	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	17 — 18	16½— 17½	17¼	16½
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	4½%	117 —121	117 —121	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	19 — 20	18½— 19½	...	...
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7¼%	10½%	14½%	16½— 17½	16 — 17	16⅝	16½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	107 —110	107 —110	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	1¾— 2¼	2 — 2½	2 3/16	2⅛
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	15 — 16	15½— 16½	16 1/16	15 15/16

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation May 18th.	Closing Quotation May 25th.	Business done during week ended May 25th, 1898. Highest	Lowest.
30,000	British Electric Traction	10	...	...	...	15½— 16	15½— 16	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £4 pd. (issued at £2 10s. prem. all pd.)	10	...	...	...	7 — 8	7 — 8	7¼	7
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅜— 2	1⅜— 2	1⅝	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2¼— 2½	2¼— 2½	2 5/16	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	103½	101¾
19,894	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10⅝	10½
129,179	Do. do. do. £6 paid	10	...	...	...	6 — 6⅓	6 — 6⅓	6¼	6 1/16
59,254	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
67,680	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼— 4⅜	4¼— 4⅜	...	...
630,000*l*	City and South London Railway	Stock	1 1/16 %	1 1/16 %	1⅞%	67 — 70	67 — 70	...	...
28,180	Crompton & Co., 7 % Cum. Pref. Shares, 1 to 28,180 ...	5	*nil*	...	...	2 — 2½	2 — 2½	...	...
99,261	Edison & Swan United Elec. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5½%	...	2¼— 2⅜	2¼— 2⅜	2⅝	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5½%	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	103 —105	103 —105	103	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	...	2⅝— 2⅞	2⅝— 2⅞	2⅝	...
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	...	3⅛— 3⅜	3⅛— 3⅜	3¼	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	106 —108	106 —108	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	1/2— 3/4	1/2— 3/4	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	5/8— 7/8	5/8— 7/8	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	12 %	10 %	21½— 22½	21½— 22½	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	106	...
37,500	†Liverpool Overhead Railway, Ord.	10	2¾%	2¾%	3¼%	10⅝— 10¾	10⅝— 10¾	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15¾— 16¼	15¾— 16¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 38	34 — 37	36	35½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	133 —136	133 —136	134	133½

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.
House-to-House, 4½% Debentures of £100, 107—110.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 15—16; 1st Preference Cumulative 6%, £5 (fully paid), 8—8½. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10%.
London Electric Supply Corporation, £5 Ordinary, 3¼—3⅜.
*T. Parker, £10 (fully paid), 15½.
Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (April 7th, 1898).

PHYSICAL SOCIETY.

ORDINARY MEETING, May 13th, 1898.

MR. SHELFORD BIDWELL, President, in the Chair.

A PAPER by Prof. W. E. AYRTON and Mr. J. MATHER, on GALVANOMETERS, was read by Prof. AYRTON.

It is a sequel to *Proc. Physical Soc.*, Vol. x., p. 393, and to *Phil. Mag.*, Vol. xxx., p. 58. The authors suggest that in future the comparative sensitiveness of galvanometers should be expressed in terms of the number of millimetre scale-divisions per micro-ampere, when the observed image or "spot" is one metre from the mirror. Unit angular deflection is, therefore, one two-thousandth of a radian. Further, for the periodic time, *i.e.*, the time between two transits of the "spot" across some fixed point on the scale, in the *same* direction, the standard should be 10 seconds. It is also proposed to reduce the factor of sensitiveness, as regards resistance, to the common basis of one ohm. The assumption is that, for a given galvanometer, the deflection per micro-ampere is proportional to the two-fifth power of the resistance of the windings. Tables accompanying the paper give complete data for a large number of galvanometers constructed during the past ten years, and it is possible to trace the improvements in sensitiveness throughout that time. The most sensitive galvanometers are the oscillographs, they have very short periods; the moving parts are small; the controlling fields very strong. They are designed to indicate the character of rapidly-varying currents. An oscillograph, as improved by Mr. Duddell, was exhibited; its period is 0·0001 per second, and its factor of sensitiveness, according to the authors' classification, is greater than any yet obtained. A distinction is drawn as to the use of the term "dead-beat." Maxwell applies it to galvanometers in which the motion is "aperiodic," *i.e.*, to those in which the suspended system, before coming to rest, passes only *once* through the position of equilibrium. This meaning is retained; it is not to be confused with "quick-moving" or "short-period." A pendulum illustrating these distinctions was exhibited. As regards insulation of galvanometers and shunt-boxes, the authors now apply the "guard-wire" principle of Mr. W. A. Price. The instrument to be insulated is enclosed in a metal case, provided with a terminal to which one end of the windings is connected. The second end of the windings passes out through an ebonite bush piece. This arrangement is said to nullify leakage and to prevent electrostatic disturbance of the suspended system. In the second section of the paper the authors calculate the limiting sensitiveness of galvanometers of the "Thomson" type. The investigation is based upon Prof. Schuster's B.A. 1894 paper, it takes into account the period of the suspended system, and the specific magnetisation of the needle. Lastly, the authors discuss the relative merits of long and short periods, *i.e.*, the best "control," for galvanometers intended to indicate zero points in potentiometer operations. They conclude that if the control can be readily altered, and if the sensitiveness can be adjusted for the test, then, for rapidity of working, the "control" should be so adjusted that the sensitiveness is approximately two or three times greater than is absolutely needed for the desired accuracy.

Prof. THRELFALL thought the author's method of comparing galvanometers very misleading. The results obtained in their comparison of the oscillograph (3,310,000), and the suspended-coil galvanometer (27) might be regarded as the *reductio ad absurdum* of the proposed system. The absurdity arose from the dissimilarity of the two instruments. Moreover, the proposed system ignored the fact that sensitiveness may be obtained by optical as well as by electro-magnetic means. Optical sensitiveness, owing to its greater stability was to be preferred to electro-magnetic sensitiveness. The fundamental problem in the construction of galvanometers is an optical one, it is necessary to decide the mass and dimensions of the suspended parts so as to ensure (1) optical accuracy, and (2) electro-magnetic sensitiveness. Thus, to some extent the weight of the mirror determines the thickness of the suspension. As an instance of what might be done by optical methods, Prof. Threlfall referred to work done by himself and Mr. Brearley (*Phil. Mag.*, 1896), in which it was possible to measure to $1{\cdot}48 \times 10^{-13}$ amperes, and, with special refinements, to 3×10^{-14} amperes. He had found that the best diameter for glass mirrors was 1·1 cms., with a weight just under 0·5 grammes. These were used with a scale at 276 cms., read by a microscope to 0·04 mm. The course of the light was: lamp, large lens, small scale, mirror, eye-piece. The period was 25 secs., and the resistance 10,000 ohms. Even better results could be obtained by using mirrors of quartz or of bloodstone. Quartz is incomparably to be preferred to glass. Such figures indicated what could be done by optical sensitiveness,

the sensitiveness that the authors ignored. It was pointed out by Prof. Threlfall that the controlling field for galvanometers of the "Thomson" type should be straight and uniform. This was best secured by using two magnets, one above and one below the needles.

Prof. Perry said the authors had not asserted that a galvanometer with higher figure of merit, according to their classification, was *superior* to another of lower figure. It must be agreed that the figure they obtain is a very valuable datum for the comparison of instruments designed for similar purposes; for instance, in classifying those used by Prof Threlfall, Mr. Duddell was to be congratulated on the extreme sensitiveness and small period of his oscillograph.

Prof. Ayrton, referring to Prof. Threlfall's *reductio ad absurdum*, admitted that the criticism would carry some conviction if the two instruments were of different kinds; if, for instance, one possessed a suspended needle and the other a suspended coil. But the argument failed, because both instruments were of the suspended coil type. In one of them Mr. Duddell had developed the advantages to be gained by reducing the air-gap. To form an opinion of electro-magnetic improvements in galvanometers, it was necessary to reduce the results of all instruments to some system of classification. There was no objection, after that, to adding a good mirror and reading by a good microscope.

The President proposed votes of thanks to the authors, and the meeting adjourned until May 27th.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The Prevention of Interruptions to Electricity Supply. By Leonard Andrews, Associate. Read May 5th, 1898.

(*Concluded from page* 708.)

Fig. 5 is a sectional elevation of a similar cut-out modified for use in connection with high-tension currents. In this arrangement the contacts are screwed and sweated into metal pots, and immersed in water. This serves effectually to quench any tendency to arcing

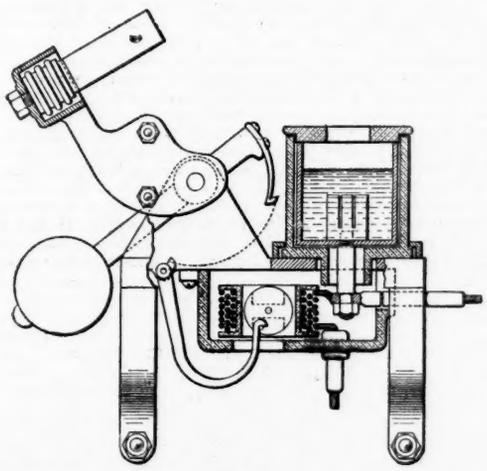


Fig. 5.

when large high-tension currents are interrupted. All the high-tension parts in this cut-out are entirely covered with porcelain or other insulating material. The releasing mechanism is practically the same as in the low-tension cut-out.

Fig. 6 is a diagram of the Hastings switch gear. We have found this arrangement entirely satisfactory in every respect. It has not only enabled us to cope with several breakdowns to machinery without interruptions to the supply, but it has also effected a saving in coal, &c., during the past 18 months of over £400. This has been saved by the arrangement referred to enabling us to work safely without running a spare plant.

All the machines are arranged to feed into a common pair of inner and outer 'bus bars. The inner 'bus bar, however, is divided at A by a change-over switch, C, into two separate branches. One of these, A_1, is permanently connected to A, but the other branch, A_2, may be connected either to the main 'bus bar or to a spare 'bus bar, B. Normally, it is connected to the former. Each machine and circuit is equipped with a two-way switch, T, by means of which any machine or any circuit may be connected either to the inner 'bus bar or to its auxiliary branch. In the diagram only three circuits and three machines are shown. The maximum output of the machines is 60 amperes, and the total load of the three circuits is assumed to be 120 amperes—namely, 60 on No. 1, 40 on No. 2, and 20 on No. 3. By setting the circuit two-way switches, T_2 and T_3, over to the left, circuits 2 and 3 are connected directly on to the A_1 branch of the inner 'bus bar; whereas, T_1 being set over to the right, circuit 1 is connected on to the A_2 branch. The machines Nos. 2 and 3 are connected in parallel by their two-way switches directly on to the inner 'bus bar, A. And the machine No. 1 is kept turning as a spare, with its two-way switch over to the right, thereby connecting it on to the spare 'bus bar, B. The change-over switch, C, is constructed to

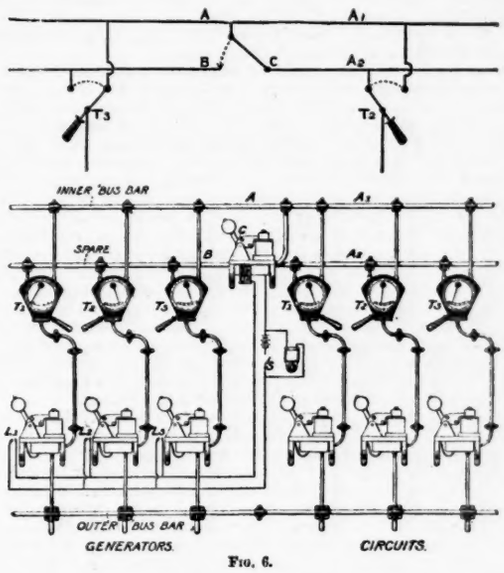
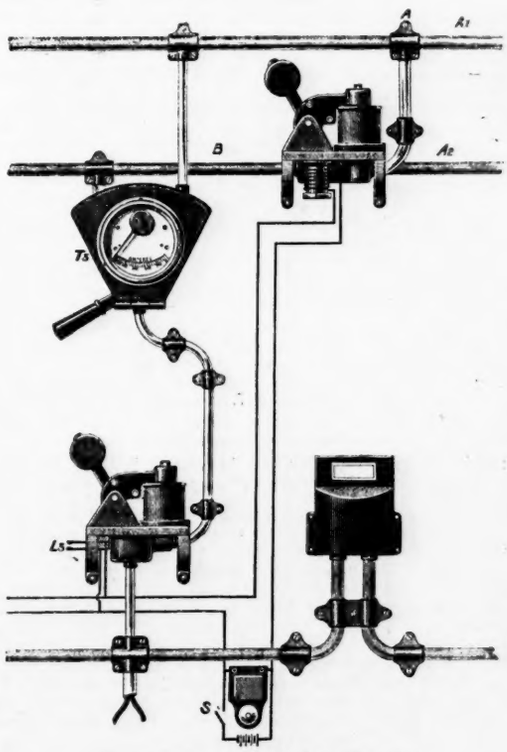


Fig. 6.

be released by a solenoid excited off any convenient source, E. Inserted in series with it are two switches, S and L_1, L_2, or L_3. Both the S and one of the L switches must be closed together to excite the



Details of one Section of Fig. 6.

solenoid. When S only is closed it completes a circuit through an electric bell, which can be heard anywhere in the station. The driver has instructions that whenever that bell rings he must immediately run the spare plant up to speed. Now if either of the running plants break down, the switchboard attendant merely has to close switch S, and then as soon as the volts on the spare machine have risen to normal, or before if necessary, he releases the cut-out switch of the faulty machine. The weight of this on falling closes

switch L, and so completes the circuit through the solenoid of the releasing change-over switch C. This disconnects the 'bus bar A_2 with its load of 60 amperes from the inner 'bus bar A, and transfers it to the spare 'bus bar B at precisely the same moment as the generator supplying 60 amperes is disconnected from the inner 'bus bar. Thus the lights on the circuits Nos. 2 and 3 are not affected as they would be if the change-over were not done simultaneously with switching out the faulty machine; and the lights on No. 1 circuit only give a momentary flicker, which, as a rule, is not even noticed by the consumers.

Of course the use of a spare 'bus bar is not original, but we believe that the simultaneous method of change-over is.

In the discussion on a paper read before the Northern Society of Engineers on switch gear last year, it appeared to be the general opinion of engineers present that all high-tension connections should be absolutely enclosed. But it was objected that it did not appear possible to do so without having exposed connections at the back of the board, and boards with backs to them increased rather than decreased the risk of accidents. A suggestion was also made in this same paper that a full sized diagram of connections painted on the walls above the switch gear would often prove useful, but other engineers thought that the switch gear should be its own diagram. We venture to think that in the switch gear shown in fig. 6 we have succeeded in complying with both of these specifications. The leads from the machines are carried in porcelain or other insulating pipes directly up to their respective cut-outs, from these to the two-way switches *viâ* their ammeters, and so on to the 'bus bars. All the high tension connections, both in the cut-out switches and the two-way switches, are entirely enclosed; and, as these switches and the conductors are bolted and clipped to the surface of a brick wall, all the connections are diagrammatically shown at a glance.

Some form of excess current cut-out should certainly be used on the feeders. We prefer magnetic cut-outs to fuses, as we find them more reliable. They can also be used as switches if necessary, which is a distinct advantage. At any rate, whatever form of cut-outs is used, their operation should on no account be permitted to interrupt the supply to any consumers.

It is curious that engineers have not paid more attention to the duplication of electrical mains. It is the custom to spend thousands of pounds on duplicating boilers, engines, dynamos, and other plant which is directly under the engineer's control; but no steps are taken efficiently to duplicate that part of the system over which he has no direct control, and which is always at the mercy of such external forces as gas explosions, burst water mains, fires, pick-holes, &c.

It is true many engineers arrange their mains on some ring system, so that any portion of it may be made dead for repairs, extensions,

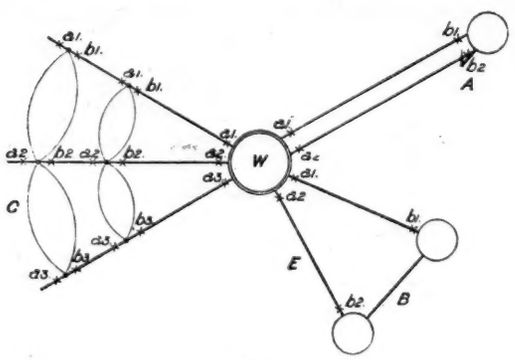


Fig. 7.

&c.; and some go even further, and fix fuses at intervals round the ring, so proportioned that a fault will only cut out a certain section of the lights. But that is not sufficient. We ought not to be satisfied until we are able to guarantee an absolutely constant supply to everyone. The problem of how to do this has been troubling us at Hastings for years. But we now feel satisfied that we have solved it. Our method of doing so is shown in fig. 7.

Each sub-station or feeding point is supplied from the works, W, by two feeders, either by running to each two distinct mains, each sufficiently heavy to carry without excessive fall of pressure half the load of the sub-station, as shown at A, or by connecting together two sub-stations, each supplied by separate feeders, as at B; or, in the case of low tension distribution, by running radial feeders from the generating station, and connecting the several feeding points on these to corresponding feeding points on an adjacent feeder by the distributing mains, as shown at C. If a fault occurs on either of these feeders, the current will be supplied to it both directly from the generating station and also *viâ* the adjacent feeder and connecting mains. To prevent this fault from short-circuiting the whole of the system, fuses have previously been inserted in the feeders at a_1, a_2, b_1, and b_2. A little consideration will show, however, that this arrangement can never be satisfactory, for it is obvious that either one of these feeders may at any time have to carry as heavy a current as the others; consequently, they must all be equally fused. Now, if a short-circuit occurs at, say, E, fuse a_2 will blow. The current will then be supplied *viâ* a_1, b_1, and b_2. Now fuse b_2 should, of course, blow, and so cut out the faulty main, leaving both sub-stations to be supplied *viâ* feeder 1. But this will not happen, because a_1 and b_1 would have to carry sufficient current to blow b_2, in addition to the useful current taken by the sub-stations. The result will naturally be that a_1 or b_1 will invariably blow before b_2, thus cutting off the lights supplied by both feeders. Now, if fuses b_1 and b_2 are replaced by discriminating cut-outs, no amount of current flowing in its normal direction will cause them to operate, but a comparatively small return current will immediately release them. As the only conditions that can possibly cause the current to flow back from the sub-stations to the generating station is a fault on the feeder between these points, this form of cut-out can be relied upon to operate only when it is required to do so.

It is, of course, very essential that the cut-outs used for this purpose should be made not to operate if either the series or shunt current is interrupted separately or simultaneously, as it would cause a great deal of trouble if the supply from the works was ever interrupted for a few seconds and all the cut-outs on the mains were thereby caused to operate.

Cut-outs that are opened with a spring or springs should also be avoided, as it is impossible to make them sensitive and reliable, owing to the fact that the catch has to be released against the maximum tension of the springs; and, further, these springs must be very stiff, as in addition to overcoming the friction of the contacts when they are clean, a large margin must be allowed to overcome the increased friction that will certainly be caused by corrosion of the contacts after they have been in, say, a few months. A falling weight seems much better suited for the purpose than a spring, for the pressure on the releasing catch is comparatively small, and the sharp blow upon the contact arm is just what is required to overcome with certainty any tendency to sticking due to corrosion.

Cut-outs should have no screws about them liable to work loose and so release the catch and open the circuit.

For burying under the pavements they should be as compact as possible, as the space is then very limited.

They should also be unaffected by rust, dust, damp, or corrosion, and precaution should be taken to prevent any possibility of their being caused to operate by external vibration. They should be made to cut out with as small a current as possible, to prevent excessive arcing when the circuit is interrupted.

The cut-out illustrated in fig. 5 has been designed to comply with these and other requirements.

Another very frequent cause of local interruptions is the failure of primary fuses of transformers. It certainly appears to be advisable to use some form of excess-current cut-out between the primary winding of transformers and the mains supplying them. But the object of this cut-out should be, not to prevent the transformers from being overloaded, but to protect the mains from being short-circuited by a faulty transformer. Where two or three transformers are coupled together no good can come of cutting one of them out of circuit because it is overloaded, for if one is cut out the extra load is thrown upon the others, thus invariably blowing their fuses as well and cutting off the supply to the whole district.

We consider that a transformer fuse should not blow unless the excess current exceeds the normal current by about 300 per cent.

Fuses between the secondaries of transformers and secondary 'bus bars are invariably worse than useless. Take, for instance, the case of three transformers of equal size feeding a common 'bus bar. If one of these fails, the current will rush back into it from the other two; but, as these have to supply the useful current to the mains, in addition to that required to blow the faulty transformer's fuse, they will blow their own fuses before that of the faulty transformer. Obviously these fuses should be replaced by discriminating cut-outs

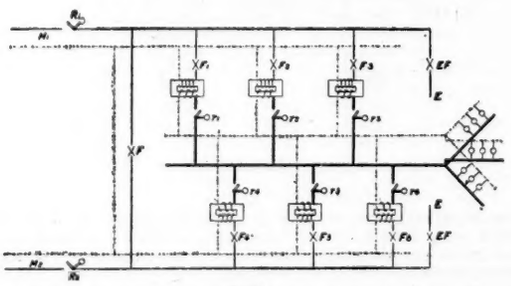


Fig. 8.

Fig. 8 is a diagram showing the equipment of a sub-station we now have in hand. The two high-tension feeders from the generating station, M_1, M_2, terminate in two return-current cut-outs, R_1 and R_2. Beyond the cut-outs they are connected together by the fuse F. Fuses F_1 and F_2, &c., are inserted in series with the primaries of each transformer. Return-current cut-outs, r^1, r^2, r^3, &c., are inserted in series with the secondaries of each transformer. The primary connections of the sub-station are divided into two distinct halves; the inner 'bus bar of each half is equipped with an earthing fuse, E F. Any man found working on the primary connections of either side without the earth fuse inserted will be instantly dismissed. Either half sub-station can, of course, be made dead by opening the return-current cut-out of the feeder to which it is directly connected, fuse F, and the secondary return-current cut-outs of that side.

There are no high-tension connections exposed in this sub-station. The primary cut-outs are of the type illustrated in fig. 5. The fuses are also of an enclosed type, and are screwed to two cast-iron frames

—one frame for each half of the station. A section of these frames is shown at G, fig. 9. The 'bus bar, B, to which the transformer fuses are connected, is supported on insulators inside this frame. These frames are hung on hinges, H, so that they can be lifted to enable the connections to the fuses to be periodically examined. High tension

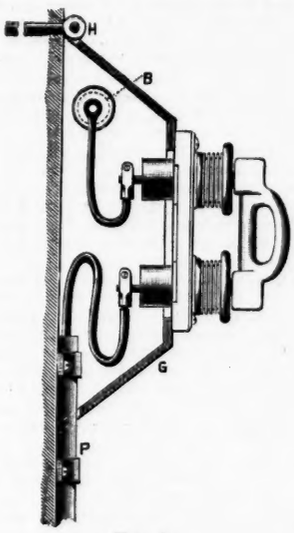


Fig. 9.

cables are run down to the transformers in porcelain tubes, P, clipped to the walls. The high tension apparatus for one half of the station is on the north wall, and that for the other is on the east wall. The low tension return current cut-outs, which also serve as secondary switches, are on the south wall, and the distributing 'bus bars and instruments are on the west wall. This sub-station is a building 12 feet long by 8 feet wide by 7 feet 6 inches high. It is built above ground in a back garden in the centre of the district it supplies. We pay £10 per annum for the rent of the ground it stands upon.

Several of our existing sub-stations are placed under the pavement. These have been such a source of trouble to us that we are now abandoning them entirely.

Arrangements are made to cut off all the transformers except one small one during the hours of light load, not only for the purpose of saving the current wasted in exciting them, but also to allow them to cool down between each heavy shift. We expect by so doing to greatly increase the life of our transformers.

Whether it is advisable to equip the low tension distributors with cut-outs or not, is a question upon which we should be glad to hear the opinion of other engineers. We are inclined to think that, if a 200-volt short-circuit occurred on a cable not exceeding 1 square inch sectional area, it would in most cases burn itself out before it damaged other parts of the cable. If we could be sure of this, we should endeavour to loop all of our distributors and insert in series with each main a magnetic cut-out adjusted to operate when the current exceeded five times the normal. If the main burnt asunder before the cut-outs operated, the supply would not then be interrupted to any consumers.

Presumably everyone will admit that excess-current cut-outs are necessary on electric light services where they enter consumers' premises, but we think the majority of central station engineers will agree with Mr. Sayers when he says that they should not operate until the normal current has been exceeded by at least 30 per cent. Is it not possible that the number of branch cut-outs at present used to comply with the fire insurance regulations might be reduced? It appears to us to be rather a question whether or no so many of these cut-outs do tend to reduce the risk of fires. Consumers who are repeatedly troubled by these branch fuses melting are apt to discover that a fuse replaced by a stout piece of copper wire gives them far less trouble. Now, if the connection to one of these short-circuited fuses should work loose, it gets hot, the heat is transmitted to the cable, and a smell of burning is the result. Of course, if no branch fuses were used, it would be advisable entirely to enclose the house wiring in some form of fireproof conduit instead of in wood casing; but we are inclined to think this would be a preferable arrangement both for the prevention of interruptions to the supply, and for the reduction of fire risks.

FAILURE OF COPPER PIPES.

It is one of the commonest experiences of engineers that materials and processes which for years give satisfaction, suddenly begin to be associated with disaster. One such instance is the brazed copper steam pipe so common in marine practice. For years satisfactory, the brazed pipe has begun to cause disaster.

Undoubtedly the use of copper pipe has come about because good copper is a tough material. It can be worked to fit the requirements of a steamer, and it can be made thin, and will follow the springing of a vessel without risk of fracture. But copper pipe has one unsound part—its brazed joint. These brazed joints have, since steam pressures became so high, commenced to give way, and the disaster on the Elbe, among many others, served to call more particular attention to the subject. At Deptford, at the electrical station, Mr. S. Z. de Ferranti adopted a novel method of pipe construction. He clustered a set of small pipes, aiming to reduce the bursting stress, and to reduce, perhaps, also the outburst of steam in case of any rupture. To give the cross-sectional area of steam, say, equal to that of a 12-inch pipe, will, however, require 16 pipes of 3 inches diameter. Each of these 3-inch pipes must be one-fourth as thick as the 12-inch pipe they replace. The mean circumference of 16 3-inch pipes is fully four times that of the 12-inch pipe, and as the fourth of the thickness of a 12-inch pipe will scarcely be sufficient for brazing purposes, it is probable that there will be a good deal more copper in a Ferranti pipe than in a single pipe of equal capacity, and the thought suggests itself why not use more material in a large pipe, and so increase its factor of safety, just as makers of shell boilers have made good work, where makers of water-tube boilers have sheltered themselves behind small diameters. But if we are to accept recent findings, the fault of copper pipes is in the brazing of them, and no amount of thickness and original excellence can be proof against a brazing which changes its nature, and becomes as brittle as a flower-pot. Various remedies are proposed, such as frequent hoops to confine a rupture within short limits, wire wrapping to take the bursting stress, and that ever dangerous hydraulic test to be applied occasionally, under the false assumption that a hydraulic test to-day will make a pipe safe for a year or two, whereas, in fact, a common result of such test is to put the pipe into a condition to burst when the next pressure of steam comes upon it. The chief engineer of Lloyd's Register of Shipping has reported upon the steam-pipe of the ss. *Pradano*, which exploded in June, 1897, and portions of which have been tested and examined by Prof. Arnold, of Sheffield.

The chief engineer and Mr. Walliker, of Cardiff, came to the conclusion that the failure was due to brazing, *originally sound*, but deteriorated by some cause. The pipe which burst had been made straight, and bent cold, proving the original excellence of the brazing. The Court which sat under the Boiler Explosions Acts of 1882, 1890, came to the conclusion that the brazing had been originally unsound, and they further considered it ought to have been hydraulically tested. They also recommend lap-welded iron or seamless steel as superior to either brazed or seamless copper. The hydraulic test is recommended to be made on pipes above 3½ inches diameter every four years—a rather useless expedient.

There was very little brazing material to be obtained from the burst pipe, but Mr. Walliker found another ship, the pipes of which showed a similar appearance, and had a considerable amount of the solder at the joints. This was submitted to Prof. Arnold, who made microscopic and other inspection, and showed that the brazing had lost a good deal of its constituent zinc, which had been dissolved out by fatty acids of oil or tallow introduced for lubrication either intentionally or as an adulterant. The zinc having disappeared left the copper as a more or less cellular mass with the pores containing the above acids. The percentage of copper was raised considerably, proving the disappearance of the zinc, and there seems no room to doubt this latter had been removed.

If this be so, it points to the absolute necessity of entirely discarding brazed pipe or of ignoring the bursting resistance, and trusting entirely to the wire serving on the outside to withstand all bursting stress. Now that copper pipes are made electrolytically without seam, there ought to be no difficulty in avoiding this very serious difficulty of brazing.

It is not that brazing is weak when made. A brazed pipe when new will test well, and give a sense of security in brazing; but now that brazing is proved so likely to fail under the influence of fatty acids generated by high temperatures it ought to be abolished. We have heard it said that electrolytically deposited copper is not particularly strong. We have no figures before us as we write, but should be glad to publish any reliable figures sent to us. In our opinion, the crux of the matter is not so much in the original tenacity of the material of a pipe as in the continuance of such original tenacity as it may possess. The tenacity being known may be suitably arranged for in the proper thickness of pipe, and if no deterioration takes place, the pipe will be as strong in 20 years as it is when new. The writer has used a good deal of electrically deposited pipe, but not under pressure, and has found it good, sound, and tough material. There appears ample reason to expect that it will remain good. Turnings cut from it were tough, like wire, and had no appearance whatever of any discontinuity of substance as might be feared from the mode of manufacture in their lamina.

Prof. Arnold's analysis of a sample of deteriorated brazing showed as follows:—

Metallic copper	76·8
Zinc oxide	22·5
Fatty acid in terms of oleic acid ...	1·4
	100·7

Yet new brazing solder by the makers of the pipe is supposed to be mixed of half zinc and half copper. A melted up sample showed only 54 per cent. of copper.

Heated to 400 C., pounded in a mortar, and fused with borax so as follow through all the operations of pipe brazing and solder preparation, there was still only 62 per cent. of copper. Yet the deteriorated brazing showed 76·8 of copper, and such zinc as there was was in the form of oxide, whence we find the true percentage of copper must have been much greater—something like 81 per cent.—proving the dis-

appearance of zinc since brazing. The failure of copper pipes is probably hastened by improper design and fixing, insufficient attention being given to expansion. A brazed pipe does not in any case appeal to an engineer's sense of the fitness of things in these days of high pressures, good materials, and facilities for securing solid-drawn or otherwise seamless tubes.

NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

ELECTRIC ELEVATORS, WITH SPECIAL REFERENCE TO THEIR STARTING AND STOPPING. Abstract of paper read by W. C. C. HAWTAYNE, May 16th.

The first electrically-driven elevator to be put to any practical use was, of course, the belt-driven machine. This consists of a winding drum on which the lifting cable coils or uncoils, and which is rotated in either direction by straight and crossed belts. These belts run on loose pulleys when the car is at rest, and are shifted over to an intermediate tight pulley, when motion is required, by means of shifting or shipping gear operated by a rope passing through the car and controlled by the car attendant. A number of these machines can be seen in our workshops and factories, the countershaft from which they are driven in some cases taking power from the works countershaft, and in some cases from a countershaft driven direct by electric motors or other available power.

When you consider that it is only about 15 years since the electric motor was really brought out, and that within a few months it was actually being used for this class of work, you will acknowledge that practical engineers saw at once how eminently suitable the electric motor was for this class of work and that they lost no time in getting it to work.

A number of these machines are still being erected, and though, of course, they differ materially in design from those first constructed, and are greatly superior both as regards safety and efficiency to the pioneer machine, yet the principle underlying them is practically the same.

It was, of course, apparent that one of the first things to do was to produce a suitable starting and stopping arrangement for the motor, for all the first machines had motors that ran continuously.

It was necessary to insert a resistance in the armature circuit of the motor to guard against a sudden rush of current at starting, and in order to control the cutting in and out of this resistance and to operate the main switch, an independent hand rope was provided, operated from the car or from the various landings.

In some cases the armature resistance was cut out by the direct pull of the rope, in others by gravity, the hand rope releasing by means of a cam, an arm which in falling cut out the different sections, the too rapid travel of the arm being impeded by a dash pot.

By the time we had got thus far, it was of course seen that there was a great future for the electric elevator as a passenger conveyer, but before it could be put to this use a decided advance had to be made—what would do for factory use would not do for passenger service.

To begin with, the loss of a few seconds in starting and stopping would be fatal to the usefulness of an elevator in a business office, the jerky motion of starting and stopping by means of a shifting belt would not be tolerated, and the safety devices were crude in the extreme.

An elevator motor must be able to work instantly with a fully loaded car, otherwise no one will be bothered with it. In the early days of motors there were objections made to starting them under load; when they were so started it was considered necessary to transmit their power by means of a belt in order to give elasticity to the system, and one thing that had to be done by the elevator engineer was to obtain a motor with a sufficiently good starting torque, and gear the armature direct to the winding drum, providing fixed brushes, and causing it to rotate in either direction without sparking. With such a machine a single-hand rope was all that was necessary to do the work originally performed by two independent ropes, and this, of course, was an advantage not to be lost sight of, as it at once relieved the car attendant of a lot of responsibility and considerably reduced the risk of a mishap.

I will now pass on to describe the modern passenger elevator as it has come under my own observation, and I think it may prove interesting if I describe at length the Otis machine, this being the one I am naturally best acquainted with.

Here Mr. Hawtayne described the Otis elevator, full particulars of which can be seen by referring to the ELECTRICAL REVIEW for February 24th, 1896.

The latest system of electric control used by the Otis Company is one in which a small pilot motor is also used, but I regret I am not yet at liberty to describe it fully. It consists of push buttons in connection with a small pilot motor, actuating a series of contacts. There are two forms of this arrangement, in one of which two buttons are used, one for the *up* motion, the other for the *down* motion and the car stops automatically at any required floor. In the second arrangement only a single push is used. No relays are required with either form.

In addition to the push buttons there are also stops in the car corresponding to the various floors. In the one button arrangement, the stop corresponding to the floor required is pressed, and then the main push is pressed, when the car commences to move towards the floor desired, no matter whether it be above or below the car at that moment. A single push button is also placed on each landing, which, when pressed, will call the car to that floor, automatically stopping it when it reaches the landing. Whenever the car is in use the pushes on the various landings are thrown out of action, so that it is impossible to interfere with anyone who may at the time be using the elevator.

Automatic door contacts and locks are also used with this arrangement, which is one that is especially suitable to private houses, accidents being practically impossible and the general arrangement being so simple that a child can use it with impunity.

I have only had an opportunity of seeing one of the machines made by Messrs. Waygood & Co., but I believe they now make some of similar type to the Otis. In the one in question the motor and gear are at the top of the shaft. A two-rope grip sheave is used instead of a winding drum. The car is counter-balanced, and the car ropes pass over the grip sheave direct to the counter-balance weights—an arrangement I do not care so much about as the drum wind. The grip sheave is geared through a worm shaft coupled direct to the armature of the motor, and the coupling between worm shaft and armature shaft is also used as the brake pulley.

The motor is of the ordinary two-pole kind.

The starting and stopping is affected by a hand rope working over a sheave keyed to a shaft connected with the switch box. Midway on this shaft is a cam, which raises by means of a bar the brake band on the coupling referred to above.

In the switch box is a main switch and a reversing drum operated by the shipper shaft. At the end of this shaft is a small cam holding up a rack and pinion device. When the hand rope is pulled, depressing the cam, the rack falls by gravity, and as the pinion is turned a pair of brushes work round a "resistance commutator" cutting out the coils. I am not aware that there is any means of re-inserting the resistance in case of an accident to the lift attendant, or should the hand rope break. Switches are provided at the top and bottom of the lift shaft to cut off current if the lift should overrun, but unless the brake is also applied the momentum of the car or balance weights might well cause an accident, and if the car should stick, and the hand rope should break, the motor might receive far more current than would be good for it.

Perhaps in the discussion a fuller description of the machine may be given, but from what I remember of some correspondence that appeared in the ELECTRICAL REVIEW* a year or so ago, the above description is practically correct, and I think the arrangement might be considerably improved upon.

The United Ordnance and Engineering Company, better known as Messrs. Easton, Anderson and Goolden, have recently taken a large number of orders for electric elevators. The principal feature in their machine is the winding mechanism, by which the disadvantages of a many grooved drum are done away with.

The gear may, as in the case of all drum machines, be placed either at the top or bottom of the lift shaft or even remote from it. It consists of a motor of either multipolar or two-pole type driving a sheave, usually provided with eight grooves, through the medium of a worm gear. A slightly smaller sheave, having four grooves, is placed either above, below, or to the side of the winding sheave according to circumstances and has its axle slightly skewed with respect to that of the main sheave.

Usually four wire ropes are employed, and they are led from the cage, either direct or over guide pulleys, first round four grooves of the winding sheave, then round the four grooves of the smaller or cross-over sheave and finally round the remaining four grooves of the winding sheave and away (over guide pulleys if required) to the balance weight.

The advantages claimed for this arrangement are:—

(1) Saving in the space occupied by the gearing, the length of travel of the car not affecting the size of the winding sheaves.

(2) Any number of ropes may be used to suspend the cage and the balance weight, without greatly affecting the size of the apparatus.

(3) The ropes always lead off in the same position and do not require space for lateral travel as when a drum is used.

(4) The car and counter-balance weights being all in one, less rope is required than with the ordinary drum.

A magnetic brake is used connected as usual in parallel with the shunt circuit of the motor.

The control of the armature resistance in the machine used to be, and I believe still is, effected by a centrifugal governor, driven off the armature shaft and cutting resistance in and out as the speed of the armature decreases or increases.

I have tried this arrangement on small service elevators, but always found it troublesome.

An emergency switch is generally fitted arranged to break the main circuit, and so cause the car to stop if by any chance its motion should not be arrested at the end of its travel by the usual stop on the hand rope.

As the company have the contract for the elevators at the New Brighton Tower, which is in the immediate neighbourhood, I hope we may hear something more of their machine in the discussion. I should like, for instance, to know what would happen to the winding ropes and counter-balance weights if the hand rope were to break and the car be brought to a standstill through any hitch occurring.

So much has been written of late about the screw and nut machine of Mr. F. J. Sprague that, although it is a distinct type in itself, I will leave it out of consideration in this paper.

The New Central London Railway some time ago entered into a contract with the Sprague Electric Company for two experimental elevators to be placed in the shaft of their Notting Hill Station, and these have done so well that I believe the firm have now obtained the contract for all the other elevators on the line.

These cars are to carry from 12,000 to 17,000 lbs. at full load at a speed of from 150 feet to 180 feet per minute.

* See our "Correspondence" columns for February 28th, March 6th, 13th, 20th, 27th, and April 3rd, 1896.—EDS. ELEC. REV.

The general arrangement is on the lines of the Sprague ordinary drum-type machine, and is somewhat similar to that of the Otis Company already described. The motor is iron-clad and shunt wound, having its armature coupled direct to a double worm shaft; the two driven gear wheels do not intermesh, but are bolted to two other gears which do intermesh and turn the winding drum.

The starting and stopping is effected by a pilot motor worked from a circular switch in the car; the brake is magnetic, and the car attendant can vary the speed of the car by the operation of the switch. The handle of the switch works against a spring action, so that if the attendant lets go or is pushed away from his post, the handle flies back, and the circuit being thus broken, the car comes to rest at once.

The duty of the pilot motor is to complete the armature circuit, and, by means of a revolving arm passing over faced contact pieces, to cut out the armature resistance.

The car attendant, by moving his switch to contact No. 1, lifts the brake and gives the machine full field; on the second contact he starts the pilot motor, which cuts out the armature resistance till he considers the car has attained the right speed; he then comes back to contact 1, or else moves on to other contacts connected with a resistance in the field circuit of the driving motor. When the handle of the car switch is returned to the normal point the revolving arm in connection with the armature resistance is returned to its normal position.

The machine is provided with a slack cable device, and a switch in connection with this device opens the brake magnet circuit and applies the brake directly anything goes wrong with the ropes.

I had hoped to give a description of the Central London Railway machines, together with some figures showing their efficiency at various loads, but I understand this is to appear shortly from the pen of Mr. Sprague himself. It will, however, give you food for thought when I say that at full load the actual efficiency of the Notting Hill machines from motor terminals to lifting ropes is as high as 70 per cent., and at one-third load 50 per cent.

I append results of tests made on two typical Otis machines, one of which was erected nearly four years ago in an office at Glasgow, the other about 18 months ago in a private house in London:—

SUN INSURANCE COMPANY, GLASGOW.

Rise of Car, 74 feet 9 inches. Speed, 170 feet. Volts, 220.
Car designed to carry 1,000 lbs.

Load.	Weight.	Time in seconds.	Amps.	Cost at 1d. per B.T.U.	Total.	Cost at 5d. per B.T.U.
1 Man	149 lbs.	up 24 secs.	1·5	·0022		
		down 26 „	26·	·0446	04682	·2341
2 Men	289 lbs.	up 25 „	4·	·0061		
		down 28 „	19·	·0324	·0385	·1925
3 „	457 lbs.	up 23 „	7·	0118		
		down 28 „	15·	·0258	·0376	·1880
4 „	597 lbs.	up 26 „	10·	0157		
		down 28 „	10·	0169	·0326	·1630
5 „	757 lbs.	up 26 „	15·	0231		
		down 27 „	7·	·0115	0346	·1730
6 „	911 lbs.	up 26 „	19·	·0302		
		down 27 „	5·	·0082	·0384	·1920
7 „	1,051 lbs.	up 26 „	25·	0412		
		down 27 „	2·	·0031	0444	·2220
8 „	1,225 lbs.	up 29 „	29·	·05		
		down 26 „	1·	·0015	0515	·2575

TESTS OF OTIS ELECTRIC LIFT AT 12, HILL STREET, W., NOVEMBER 27TH, 1896.

No. of Test.	1	2	3	4	5	12	7	8	9	14	15	18
Direction	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
Load ... ... lbs.	648	648	506	506	336	336	171	171	0	0	336	336
Travel ... ... feet	36·5	36·5	36·5	36·5	36·5	36·5	36·5	36·5	36·5	36·5	24·75	24·75
Time per trip ... ... seconds	23·0	22·0	25·0	21·0	22·0	23·0	22·0	22·4	22·0	24·0	16·4	16·0
Maximum current ... ... amps.	13·0	11·0	12·0	12·0	11·0	12·0	10·0	11·0	12·0	12·0	12·0	12·0
Average „ ... ... „	11·5	3·0	8·5	4·0	6·5	6·5	4·25	7·5	2·5	·95	6·5	5·5
Duration of current ... seconds	28·6	23·2	27·2	23·2	25·2	24·0	24·0	24·2	23·4	25·8	17·6	16·4
Energy per trip ... ... watt-hours	19·8	5·6	15·6	7·08	11·2	9·27	7·8	12·68	5·37	16·35	8·3	6·83
Cost per single trip at 4d. per unit ...	0·079	0·0225	0·0624	0·0283	0·044	0·037	0·0312	0·0509	0·0214	0·0655	0·0334	0·0273
„ „ double trip	0·1015		0·0907		0·08·8		0·0·21		0·0869		0·0..05	
Average current from meter reading amps.	12·2	4·25	10·2	5·4	7·9	6·9	5·75	9·20	4·0	11·2	8·3	7·4
Average speed ... feet per minute	78·0	99·5	87·5	104·0	99·5	95·0	99·5	98·0	99·5	91·0	90·0	92·7

In conclusion, gentlemen, I would draw your attention to the tremendous strides that are being made in the elevator business. I have seen it boldly stated, and I have no doubt it is true, that in the States more people are carried vertically in elevators than horizontally by street cars. When the electric elevator was introduced here makers of hydraulic lifts went about trying to prove how expensive they were to buy and to maintain, but most of them have since been converted, and now that they have mastered the principles of the machinery, and have seen the immense advantages to be obtained by the use of electric power, they have started into the field themselves. Some of the machines produced are very good, some are marvels of how not to do it. I was called to one a few weeks ago in London—it was a case where the lowest tender was accepted,—which absolutely had not a good point about it, and on which I refused to travel. A specification had been prepared by the manufacturers duly setting forth that the machine was equal to any of the more expensive machines, and would be provided with switches and all the latest improvements, including resistance in the armature circuit to be cut out as the machine acquired speed. The consulting engineer was satisfied and the contract made. The resistance in the armature circuit turned out to be a hand arrangement, and the motor now has to run continuously, being thrown on by a wonderful friction gear; it is only brought into use on the "up" motion, and the car drops by gravity on the "down" motion, acquiring speed at such a pace that the shock of stopping nearly throws the passengers off their legs, and brings in the safety device nearly every time. You can hear the noise of the gear wheels (not worm gearing) out in the street, and the whole construction of the machine is bad. A great deal of experience and thought is required to design a first-class elevator, and I hope many of you will take the subject up. At present, there is no alternate current motor that I know of that can be used in this connection. This is an enormous drawback, for many of our largest towns are supplied, as you know, on the alternating system, and I have personal knowledge that many orders could be obtained for electric elevators in these places if the machinery was forthcoming. Perhaps during the discussion someone may be able to show us how to do it.

I had hoped to give you more data with regard to loads and efficiencies, but manufacturers are still averse to letting others know too much, and so I have only been able to give you generalities. Data that I have been promised has not yet come to hand; when it does I may find a means of communicating it to you, if the subject is of sufficient interest.

THE TELEPHONE SERVICE.—CONFERENCE AT SPRING GARDENS.

AT the County Hall, Spring Gardens, on Monday, Mr. McKinnon Wood (chairman of the London County Council) presided over a Conference between the London County Council and Municipal Corporations, representatives being present from Belfast, Brighton, Salford, Bedford, Liverpool, Huddersfield, Leeds, Halifax, the City of London, Blackburn, Gateshead, Leicester, Newcastle-on-Tyne, Norwich, Oldham, Plymouth, Portsmouth, Sheffield, Cardiff, Tunbridge Wells, and Bradford.

The CHAIRMAN, in opening the Conference, said that the matter of the Telephone Company was one upon which great disadvantages would arise from isolated action. They had had to call that Conference upon short notice, because the Select Committee which had been appointed had begun to take evidence. The evidence given was of a very interesting character, showing that the position of the National Telephone Company throughout the country was an exceedingly strong one, and one which behoved them, as representatives of the towns of the country, to consider with a good deal of care. A practical monopoly had been conferred upon the Telephone Company, he thought he might say, without the safeguards which were usually attached to such a monopoly. They had to consider how far the telephone service was likely to prove of general benefit, and how far there was a possibility of its further extension, if it could be perfected and reduced in cost. He thought it was obvious that municipal authorities would not go in for a telephone system if a license was only granted to them to 1911. The L.C.C. had passed no resolution for submission to the meeting.

Mr. J. W. BENN (L.C.C.) moved: "That in the opinion of this Conference the telephone service is calculated to become of great general benefit, and is so much in the nature of a monopoly, that it ought not to be left permanently in the hands of private undertakers." He

said that it would be a great advantage to the State if it decided to take the telephone system over, to have a municipal system working beside a private company.

The Town Clerk of Salford seconded the resolution, which was carried.

Mr. Thornton (L.C.C.) compared the cost of the telephone system in Stockholm and Douglas with that of London, and said it was reserved to the greatest city in the world to be charged eight times as much for their service as the people of Stockholm. He moved: "That the evidence afforded by foreign towns and cities shows that similar places in this country—especially London—do not utilise the telephone for business and private purposes to nearly the same extent as abroad, and that such non-user arises mainly from excessive charges and inefficient service."

The Town Clerk of Liverpool, in seconding the motion, said that the inefficiency of the service was in a great measure due to the short-sighted policy of the Government, who might have acquired the whole system for £100,000 years ago, whereas now it would cost millions. He suggested the addition of the following words: "And the failure of the Post Office Department to provide an adequate number of trunk lines to connect the local exchanges."

The addition was accepted, and the resolution, as amended, agreed to.

The Lord Mayor of Belfast next moved: "That in the event of the Post Office being unable to take over the whole telephone service of the country, it is practicable and advisable that municipal authorities should be empowered to provide such service in their respective localities, on the understanding that every facility will be afforded for close co-operation between the local authorities and the Post Office."

The Town Clerk of Leeds seconded.

The Town Clerk of Huddersfield moved the following amendment: "That in the opinion of the Conference, it is expedient that municipal and other local authorities should undertake the telephone service within the area composed of their own districts or a combination of such districts."

Mr. Boyle (Bedford) seconded the amendment, and said that he had worked out the cost, and found that in Bedford, with 500 subscribers, they could work an exchange for £2 5s. a year, and after five years make a profit of something like £5,000.

Mr. Morton (City) observed that the Post Office officials seemed completely captured by the private company.

The Town Clerk of Liverpool said it was no good talking about having a £3 municipal service if they could not get communication with other places. It was a national question, and they wanted the great commercial houses of the country to be in a position to have a good service. It was playing with the question to say that a few isolated corporations would start a system of their own.

The amendment was lost and the resolution carried.

Mr. Dickinson (L.C.C.) moved: "That as the National Telephone Company obtained its powers and raised its money upon the basis of being subject to actual effective competition, it is just and expedient that steps should be taken to protect the public against the practical monopoly that the company has obtained for itself, and against the inordinate charges that are only leviable by the company by reason of such monopoly."

Mr. Green (Norwich) seconded the motion, and it was carried.

Mr. Baker (L.C.C.) proposed: "That, as one of the causes of the excessive charges is the fact that the company's capital, upon which dividend is paid, has been swelled by the expenditure of large sums of money not represented by any works, it is inequitable that the public should be forced into the position of either having to submit to such charges permanently, or having to buy out the company on the basis of such charges."

This was carried without discussion.

Mr. Benn (L.C.C.) moved: "That seeing that the license of the National Telephone Company will expire in 1911, it is expedient (*a*) that Parliament should decide that no extension of the license should be granted to the company; (*b*) that in order that the public may be provided with a telephone service by 1911, the various municipal authorities be granted licenses to establish and work local telephone services prior to that date, and that such licenses shall only be terminable on the payment by the State of the outlay of the undertakings."

Recommendation (*a*) was agreed to without dissent, but considerable discussion took place on the second recommendation, which was eventually amended so as to provide that any license granted to a municipal authority should give leave to speak over the trunk lines.

On the motion of Mr. Benn, the following resolution was agreed to without discussion:—"That the power of the breaking up of the streets which is claimed on behalf of the National Telephone Company—acting through the Postmaster-General—is a grave interference with the rights of municipal authorities."

It was resolved that the views of the Conference be placed before the Select Committee.

ELECTRIC LIGHTING IN ST. PANCRAS DURING 1897-1898.

An epitome of the work of the Electricity and Public Lighting Committee of St. Pancras Vestry during the year 1897-98 has been prepared and presented to the Vestry by Mr. H. J. Menzies, chairman of the committee. The report is accompanied by a diagram showing both the expenditure and income since 1892, and that for the first time the private lighting income (for 1897) has exceeded the total expenditure by nearly £3,000. The following figures indicate the selling and cost price per unit each year from 1892:—

Year.	Average price realised.	Average cost of production.	Total cost.
	d.	d.	d.
1892	6	4·6	6·88
1893	6	3·5	5·3
1894	5·6	3·2	5
1895	5·3	3·5	5·1
1896	5·4	3·8	5·8
1897	5·2	2·9	4·2

It will be seen from this that last year, whilst by far the most prosperous of the series, realised the lowest average in price, which is, with one exception, the lowest also of any of the Metropolitan supply companies. The alteration in the method of charging, recommended to the Vestry in January, and now further modified, together with the reduction in the charge for public lighting, will probably make the St. Pancras rate the cheapest in London.

Another satisfactory feature is the great diminution in cost. It is interesting to note that in the revised original estimates, on which the Vestry commenced operations, the price per unit was fixed at 2·45 pence works' cost, and ·75 pence for interest and repayment charges. The former figure might have been realised but for the heavy repairs, and probably will be reached immediately; the latter seems altogether too low. Either more was expected of a limited area than it has been found to yield, or money was sunk in unproductive mains: in any case the capital expenditure has involved a heavier burden than ¾d. per unit. It is possible, however, that when the full benefits of the chief engineer's invention of the 220 volts system are obtained, the original figure may not be far exceeded.

Analysis of Costs in Pence per Unit.

—	Coal.	Oil, waste, &c.	Wages.	Maintenance and repairs, including carbon.	Rates.	Management, insurance, law, &c.	Total.
	d.	d.	d.	d.	d.	d.	d.
1892	1·63	·24	1·30	·34	—	1·08	4·60
1893	1·26	·17	·72	·92	—	·43	3·50
1894	·99	·15	·71	·80	·10	·46	3·21
1895	·95	10	·67	1·18	·10	·49	3·49
1896	·99	·17	·72	1·07	12	·73	3·80
1897	84	09	63	·92	·09	33	2·89

The report points out that the coal consumption shows much improvement, but the expenses for maintenance and repairs continue abnormally heavy. The fact is, Mr. Menzies states, that the system is being reconstructed out of revenue, but it is to be hoped the most of the early faults are now removed.

The business, which has more particularly engaged the attention of the Electricity and Public Lighting Committee, has been that of extending the Stanhope Street station. This important step was forced upon the committee by the increasing demand for current, which has so grown that at Christmas much anxiety was felt by Mr. Baynes lest the requirements should be more than the plant could supply. Consumers have come on very fast, especially during the past three years; and as the committee have to anticipate their wants by at least 18 months, their action was not taken a moment too soon, for both stations are already almost fully loaded. The plans of the engineer were of a very comprehensive character, both doubling the capacity of Stanhope Street station and adding greatly to its efficiency; and although some opinion was expressed that a third station should be built elsewhere, the advantages of enlarging the existing one on a site quite ready for use weighed down every other consideration. The new work will probably cost £45,000, but no one who has studied the business can doubt that it will prove a most remunerative outlay. The bulk of the contracts are now placed, and it is much to be hoped such progress may be made that some of the new machinery will be in position for next winter's work.

In addition to the increase of generative power, the decision to carry the mains to Highgate almost completes the arterial system of distribution, all the boundaries of the parish having thus been reached. The extension to Queen's Crescent, Malden Road, and Prince of Wales Road takes up all the remaining important thoroughfares as yet unsupplied with current.

The work of public lighting goes on slowly, but, owing to the precautions imposed last year on the engineer, its early stages are of a difficult and complicated nature. The Gray's Inn Road extension has come into operation, and the Kentish Town Road section is nearing completion. When the Highgate and Malden Road arcs are installed there will be 222 lamps in operation, and it will be the duty to consider by what further action the Vestry can entirely supply itself with the means of street illumination.

Naturally with an increasing revenue and the prospect of a favourable balance, claims have been made for reduction in price. After much consideration the committee adopted the maximum demand indicator as the first step towards fairly effecting this object. There is no doubt that Dr. Hopkinson's method, favoured by the engineer, is theoretically the right one, that every lamp in use should pay a fixed sum towards the standing expenses of the station after which current could be supplied at a slight advance over the cost of

coal, labour, and wear and tear of machinery required in its production. But this has many practical difficulties, and to adapt it to a business built up on different lines was a hopeless endeavour. Next in scientific value is the so-called Brighton system, the success of which is shown by its general use for municipal charges. This achieves the same result as is sought by Dr. Hopkinson, and when its application becomes general in St. Pancras on the basis now accepted, it will not only give considerable relief to consumers, but stimulate as well a large extra demand. The vestry is rapidly approaching in its tariff a point when electricity becomes as cheap as gas, and there seems no reason, why in the near future customers whose use of it can average four hours a day during the winter half of the year will be actually paying less.

By direction of the Vestry the committee have had to consider the question of lighting Somers Town, but pressure of business has prevented the engineer preparing his report in sufficient time for decision. This, however, must come up for judgment shortly, either as a special case or as part of a large and general scheme for covering the parish with electrical illumination.

A matter that must not escape notice is the decision of the Home Secretary that the generating stations fall under the operation of the new Workmen's Compensation for Injuries Act coming into operation on July 1st of this year. It will be necessary to make some provision to meet the obligations of this Act, and early action is desirable.

The closing month of the committee's term of office has seen the partial realisation of a hope which originally connected the King's Road station with the dust destructor, that the latter could supply the engines with steam. It cannot be said as yet what is the practical value of this supply, and the investigation Mr. Baynes has been authorised to make must determine to what extent it can be turned to use.

ELECTRICAL ENGINEERS (R.E.) VOLUNTEERS.

It will be seen from the annexed rules that the War Office have made an important change in the regulations for efficiency of the Electrical Engineers Volunteers. By the regulations originally proposed, recruits were required, in addition to military drills and eight days' training in camp, to attend 78 technical drills. By the modified regulations the 78 technical drills are reduced to 12. Whilst this will make the work of recruits living in London much easier, it will also make it quite practicable for men residing at a distance from London to join the corps, they will obtain their purely military training with any volunteer corps in their own neighbourhood, and will complete their technical training by attending in camp two additional days, making, with the eight days' training required from all, a total of 10 days. No doubt these altered conditions will conduce very materially to the greater success of the corps. The rules are now as follows:—

The headquarters of the corps are at 13, Victoria Street, Westminster.

The uniform will be the same as that worn by other Royal Engineer Volunteers, with such modifications as the War Office approve. Uniform will be supplied free to members.

The corps will be armed with the Lee-Metford rifle.

The training is divided into two kinds—military and technical.

The military work consists of infantry drills, musketry, &c.

The technical work includes every application of electricity to war, with the exception of telegraphy, and such other work as will be useful to an electrician or engine-driver in carrying out his duties, such as signalling; fitting, loading, priming, and connecting up submarine mines; a certain amount of boat work, and knotting, splicing, &c,

This work will be carried out partly in London, but mainly at defended ports.

In order to become efficient, each member must attend a continuous training at a defended port for at least eight days each year. In addition, 12 hours' technical work must be done each year. For this purpose, each working day—after the first eight—of the continuous training counts as six hours; each half-day four hours. Or, these drills may be done in periods of 1, 1½, 2, 2½, 3, and 3½ hours.

The capitation allowance is £4.

For each of the eight days of the continuous training, an allowance of 5s. per member in camp is paid to the corps. The allowance will be primarily devoted to the maintenance in camp.

Drills—both military and technical—are being carried out in London and Woolwich at present.

Members from other districts will only be permitted to join on undertaking to make private arrangements to learn their infantry drill.

Intending members are requested to study the conditions of efficiency.

Below will be found an extract from the rules of the corps:—

5. Every enrolled member who is non-efficient in any year shall pay to the funds of the corps, on or before November 10th in that year, a sum equal to the Government capitation allowance which he failed to earn. . . . . The commanding officer shall have power to remit payment, wholly or in part, in special cases.

8. No person shall be admitted as member or honorary member unless proposed by one or more members of the corps, and approved by the commanding officer.

24. Any member wishing to leave the corps may do so on November 2nd, providing he shall have given notice of his intention not later than the 30th of the preceding September. Failure to comply with this rule shall render him liable for half the amount of the succeeding year's capitation grant.

Note.—Age limit 17 to 47 years.

Intending members should write to the adjutant, Captain Brady, R.E., 13, Victoria Street, S.W., who will supply all information. They should give their full name, address, occupation, and electrical qualifications. If they wish to join as engine drivers, they should state their qualifications for that work.

Every application must be accompanied by a reference to a member of the corps or to some other person well known to the commanding officer.

Before enrolment, each candidate must be passed as fit by a medical officer.

Every member shall be enrolled for three years at least. A member leaving before completing three trainings shall be liable to a penalty of £2 10s.

Note.—The headquarters are open on week days from 10 to 4, Saturdays from 10 to 12. On Mondays and Thursdays at 8 p.m. in addition.

J. Hopkinson, F.R.S., Major,
Commanding the Electrical Engineers, R.E. (Volunteers).

REVIEWS.

A Treatise on Magnetism and Electricity. By Andrew Gray, LL.D., F.R.S. London: Macmillan & Co., Limited.

Messrs. Macmillan have sent to us the first volume of this work by Prof. A. Gray. It is pleasant to recognise the learning and scholarship of the author in such a handsome material form. The matter of the book, so far as this volume goes, is arranged in the logical order suggested by modern conceptions of magnetism, and though possessing no originality in matter or treatment, is the most philosophical connected statement of these conceptions we have seen. The production of this work is creditable to the author, and to the distinguished school of physicists that trained him. The book is beautifully printed and got up, and will no doubt find a place on the shelves of all mathematical physicists. We could wish the author had the courage of his convictions in the matter of the Heavisidal units. The magnetic pole is now to everyone the source of magnetic flux, only secondarily the centre of magnetic force, and we do not believe the adoption of the corresponding definition would cause any confusion through our use in practice of the ampere and the ohm. Probably 19 out of 20 electricians are more or less agreed about this, and not 1 in 20 will act on the consensus. Prof. Gray's preface shows that he is, as every teacher must be, alive to the philosophical value of a change. The defect of the book, if it is a defect, is its very close following of Lord Kelvin in subject and mode of demonstration, but it seems that the time cannot be distant when a satisfactory hypothesis for the conditions of the ether will be devised, and all electrical phenomena will be deducible from the laws of these conditions. Then the books can be re-written on an exact basis, and the work of the great physicists built into a perfect structure. May we be there to see!

The Standard Electrical Dictionary. By T. O'Conor Sloane, A.M., E.M., Ph.D. London: Crosby Lockwood and Son.

This dictionary of electrical terms is not only a useful work for present reference, but promises to be of great interest in the future. Electricity is the mother of a great family of new ideas, new terms, and new inventions. Many of these are already obsolete, and others continually become so, and a book which condenses into a small space short statements and illustrations of all the terms in use at any given date is of great value: and this small volume contains all sorts of electrical terms, some scientific, some slang, that one ever meets. It is not very serious lexicography, nor are the definitions too precise, and except in a few cases of conspicuous difficulty, *e.g.*, induction, and resistance, the treatment is very terse; but for the object of the book this is undoubtedly a merit. To a non-expert electrician the book would be useful and interesting; for a professional man the matter is hardly exact enough to be very valuable.

Practical Telephony. By JAMES BELL, A.I.E.E., and S. WILSON. London: *Electricity*, 11, Ludgate Hill, E.C.

This is a republication in book form (with additions) of a series of articles which appeared in the pages of our contemporary *Electricity*. It describes—much after the manner of earlier works—various types of telephonic instruments. It is perhaps chiefly valuable for its description of the apparatus now used by the Post Office, and also for domestic apparatus. Exchange working generally is somewhat beyond its scope. The authors believe that "there is room for a simple telephone manual at a moderate price," and two shillings and sixpence will doubtless be considered as coming within the lines of moderation.

A Popular Guide to Commercial and Domestic Telephony. By M. BYNG, M.I.E.E., and F. G. BELL. London: The General Electric Co., and Whittaker & Co., 2, White Hart Street, Paternoster Square.

This work mainly deals with apparatus furnished by the firm whose name is given as joint publishers. Its object is "to assist the fitter to obtain some knowledge of the telephone, both theoretically and practically," and, being written from the standpoint of the non-expert, it covers much elementary ground. Some of its statements may be open to question, as for example, the origin suggested for the discovery of the microphone on page 16, but the main object of the work is descriptive of apparatus which is, on the whole, well done. It may perhaps be doubted if the non-expert, for whom the work is intended, will make much of the instructions for discovering faults on page 142. The work is well printed and furnished with good blocks and clear diagrams.

First Stage Magnetism and Electricity. By R. H. JUDE, M.A., D.Sc. University Correspondence College Press. London: W. B. Clive, 13, Booksellers' Row, Strand, W.C.

The book is intended primarily to cover the syllabus of the elementary stage of the Science and Art Department. The author admits that there are already a number of books in existence written for the same subject, but he argues that none of them present the subject of *electrical potential* clearly to the student. Whether the failure to make this particular point clear is a sufficient justification for the issue of a new book dealing with the whole general subjects of electricity and magnetism, may be doubted. We cannot, however, find fault with Mr. Jude's production nor his attempt to compete with others who may have written books equally good and of equal utility with his own. With the exception of the particular point (certainly an important one) with reference to electric potential there is but little originality in the work; it is, however, perfectly sound and can, therefore, be safely and profitably used for the purpose intended.

NEW PATENTS.—1898.

Compiled expressly for this journal by* W. P. THOMPSON & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.

10,535. "Improved method of winding armatures of dynamo-electric generators or motors." W. R. V. MARSHALL and PATERSON, COOPER & Co. Dated May 9th.

10,557. "Improvements in and relating to electric furnaces." T. JACKSON. Dated May 9th. (*Complete.*)

10,585. "Improvements in electric resistances." W. P. THOMPSON. (The Chemisch Elektrische Fabrik "Prometheus" Gesellschaft mit beschrankter Haftung, Germany.) Dated May 9th. (*Complete.*)

10,599. "Improvements in electrical devices for igniting liquid burners." THE REFORM PETROLEUM BELEUCHTUNG, GESELLSCHAFT M. B. HAFTUNG and E. WEINHAGEN. Dated May 9th. (*Complete.*)

10,606. "An electric signal bell for cycles." S. KRAUS. Dated May 9th. (*Complete.*)

10,608. "Improvements in electrically illuminated buoys." H. H. LAKE. (P. C. F. Hoffman, Germany.) Dated May 9th.

10,611. "Improvements in electric primers for firing guns." C. A. MCEVOY. Dated May 9th.

10,615. "Improvements in automatic apparatus for receiving the charges for telephone conversations and telegrams." L. M. ERICSSON and S. RITTER. Dated May 9th. (*Complete.*)

10,616. "Improvements in enclosed arc lamps." G. T. DAVIES. Dated May 9th.

10,617. "A controlling switch for large numbers of electric circuits." H. K. SMITH and J. ECK. Dated May 9th.

10,618. "An improved indicating and recording apparatus for use in connection with electric meters." G. C. PILLINGER. Dated May 10th.

10,647. "Improvements in electric incandescent lamps." W. J. PHELPS. Dated May 10th. (*Complete.*)

10,650. "Improvements in and relating to electric arc lamps." F. A. GILBERT and E. O. LUNDIN. Dated May 10th. (*Complete.*)

10,652. "Improvements in electric condensers." C. S. BRADLEY. Dated May 10th. (*Complete.*)

10,690. "Improvements in starting devices for single-phase alternating electric current motors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (J. P. Stone and S. E. Doone, United States.) Dated May 10th. (*Complete.*)

10,705. "Improvements in electric motors and meters adapted for use with alternating currents." H. P. DAVIS and F. CONRAD. Dated May 10th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, October 22nd, 1897, being date of application in United States.)

10,805. "Improvements in primary batteries." F. H. PERRY. Dated May 11th.

10,808. "Improvements in Morse telegraph apparatus." SIEMENS BROS. & Co., LIMITED. (A. Tribelhorn, Argentine Republic.) Dated May 11th. (*Complete.*)

10,816. "An electrical two-way pear or pressel switch." J. W HINTZL. Dated May 11th.

10,818. "Improvements in electricity meters." G. HOOKHAM. Dated May 11th.

10,821. "Improvements in the manufacture of electro-plate." S. COWPER COLES. Dated May 12th.

10,848. "Improvements in dynamo-electric machines and motors." S. G. BROWN. Dated May 12th.

10,869. "Improvements in electrical clocks." A. GRIFFITHS. Dated May 12th.

10,883. "Apparatus for transmitting motion to a distance by means of electrical energy." SIEMENS BROS. & Co., LIMITED. (Siemens & Halske, Acktien-Gesellschaft, Germany.) Dated May 12th. (*Complete.*)

10,900. "Improvements in electric arc lamps." W. L. WISE. (J. H. Hubbell, United States.) Dated May 12th. (*Complete.*)

10,901. "Improved system of vacuum tube lighting and apparatus for use therein." W. L. WISE. (The Moore Electrical Company, United States.) Dated May 12th. (*Complete.*)

10,922. "An improved switch for electric motors." A. E. TANNER and F. A. C. LEIGH. Dated May 13th.

10,941. "Improvements in conduits for electric railway and tramway traction." E. C. HOEGERSTAEDT. Dated May 13th.

10,942. "Improvements in electro-magnetically operated switches for strong electric currents." E. C. HOEGERSTAEDT. Dated May 13th.

10,960. "Improvements in electrical storage batteries or accumulators." J. B. SCAMMELL. Dated May 13th.

10,979. "Improvements in and in the production of glass globes, chimneys, lenses, and such like, for electrical, gas, and oil illumination." H. CRUDGINGTON, W. CRUDGINGTON, and W. R. RIDINGS. Dated May 18th.

11,044. "Process and apparatus for covering metallic wires with asbestos for insulating and other purposes." E. ALBASINI. Dated May 14th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, December 3rd, 1897, being date of application in Italy.) (*Complete.*)

11,051. "Improvements in apparatus for use in the electro-deposition of zinc or other metals." THE COWPER-COLES GALVANISING SYNDICATE, LIMITED, and S. O. COWPER-COLES. Dated May 14th.

11,068. "Improvements in the production of zinc and sulphate of copper by electrolysis." H. H. LAKE. (A. Lotti, Italy.) Dated May 14th.

11,075. "Improvements in apparatus for vacuum tube lighting." W. L. WISE. (The Moore Electrical Company, United States). Dated May 14th. (*Complete.*)

11,076. "Improvements in and relating to telephone installations." E. BAIVE. Dated May 14th.